

SUSTAINED YIELD IN TASMANIAN FOREST MANAGEMENT :
AN EXAMINATION OF THE CONFLICTS BETWEEN SUSTAINED YIELD
MANAGEMENT AND THE PROVISION OF NON-WOOD VALUES

by

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STATEMENT

This thesis contains no material that has been accepted for the award of any degree or diploma in any university and to the best of the author's knowledge contains no copy or paraphrase of material previously published or written by other persons except when due reference is made in the text of this thesis

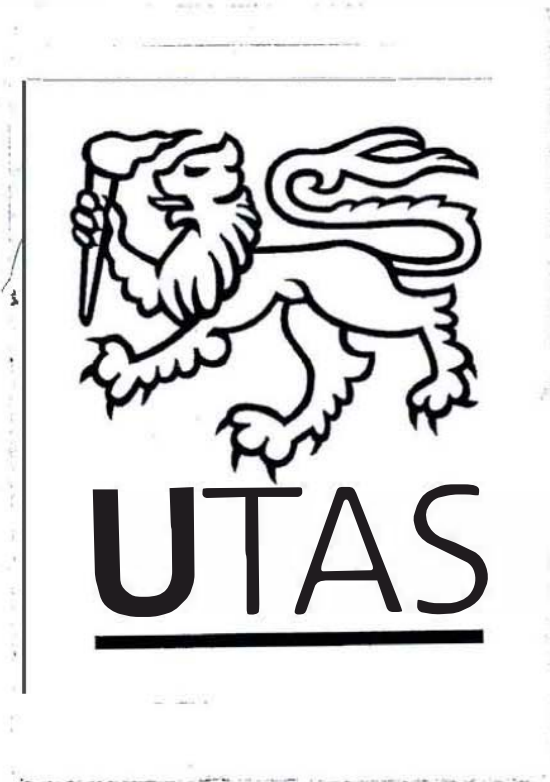
ABSTRACT

The traditional principles of sustained yield have long been relied upon in the planning of forestry management. Along with the more recently introduced concept of multiple-use, sustained yield remains the catchcry of forest managers. The principles of sustained yield concentrate on planning the extent and timing of harvesting for wood production objectives. However, in the transition from forestry management to forest management, these principles, with their heavy emphasis on wood production objectives, have been at variance with the multiple use concept in a number of ways. This study attempts to document these areas of conflict for forest management in Tasmania.

Sustained yield management in Tasmania is carried out on a regional basis. One of these regions, the Southern Forests, is used as a case study for examining the compatibility between the application of sustained yield and multiple use concepts. The techniques of sustained yield management used in the Southern Forests are documented with particular attention being paid to the assumptions made in the planning of management operations. These assumptions are then analysed in terms of their potential effect on management's ability to incorporate non-wood objectives in its planning.

The study concludes that while strong reliance on the traditional principles of sustained yield is maintained, non-wood values will only get partial consideration in forest management planning. This consideration is usually given where there is only

minimal interference with wood production objectives. A change in the present use of sustained yield estimates and a shift in the emphasis of data collection are suggested as preliminary steps in ensuring that non-wood values are given adequate consideration in forest management planning.



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CHAPTER ONE : WHY EXAMINE SUSTAINED YIELD IMPLEMENTATION ?

1.1 Adherence to the Sustained Yield Concept

The close association between forest management and the concept of sustained yield dates back to the origins of forestry management in central Europe in the 17th and 18th centuries. At the time, the effects of overexploitation of the accessible timber resource motivated the development of techniques for estimating cutting volumes that would allow timber supplies to be ensured for present and future generations (Lee 1982; Gadow 1980).

The technique used for estimating sustained yield in these early attempts at timber resource conservation spread, in conjunction with the introduction of forestry management practices, to most other regions of the world. Early policy statements of forestry management objectives in Australia promoted the idea that "the forest should be managed to give within economic limits the maximum sustained yield" (Steane 1935).

Since its introduction into Australia, the concept of sustained yield has been enthusiastically retained and promoted as a cornerstone of forest management, as is witnessed in statements such as those by Underwood (1983) : "[Planning for sustained yield] ...developed in Europe in the 17th Century. To this very day the formulae and techniques involved are taught as an ideal to every young forester". Likewise, the remarks of Moulds (1972), when he was

chairperson of the Forests Commission of Victoria, illustrate the degree of reliance placed upon the concept by forest managers : "The forester has never wavered from the traditional principle of sustained yield".

1.2 The Need To Examine Sustained Yield Implementation

However, since the early 1970s, forest managers in Australia have not enjoyed the level of unquestioning reliance that they have placed upon the concept of sustained yield. Indeed, "over the last decade forest management has become one of the major Australian conservation issues" (Rawlinson and Penna 1982). Conservationists have not been alone, though, in criticizing current forest management. Resource economists have criticized current forest management practices for being economically inefficient, in that present management does not optimize resource allocation (Pearse 1967; Weetman 1971; Samuelson 1976).

The extent of concern generated by the issues involved in forest management can be appreciated by considering the number of public enquiries there have been regarding forest management in Tasmania or pertaining, in part, to Tasmanian operations since 1970. The following list covers most of the public enquiries that have been held since 1970 :

- 1971 Inquiry into the **Economics of the Australian Timber Industry**; Department of Trade and Industry.
- 1972 Inquiry into **Forest Regeneration**; Tasmania, Legislative Council.

- 1974 Inquiry into the Future Development of Forestry and Wood-Based Industries; Australian Forestry Council.
- 1975 Inquiry into the Economic and Environmental Aspects of the Export Hardwood Woodchip Industry; Australia, Parliament.
Inquiry into the Impact on the Australian Environment of the Current Woodchip Industry Programme; Australia, Senate.
- 1977 Inquiry into Woodchipping and the Environment; Australia, Senate.
Inquiry into Private Forestry Development in Tasmania; Tasmania, Parliament.
- 1978 Inquiry into Royalties and Road Charges; Tasmania, Parliament.
- 1981 Inquiry into All Aspects of Australian Forestry and Forestry Based Industries; Australia, Senate.
- 1984 Inquiry into State Forestry; Tasmania, Legislative Council.
- 1985 Inquiry into Environmental Impact Statement on Tasmanian Woodchip Exports Beyond 1988; Tasmanian Woodchip Export Study Group.

Part of the concern voiced by the conservation movement is that foresters are carrying out forest management too restrictively, concentrating on wood production as the dominant use. Conservationists question the appropriateness of wood production as the dominant use for most forests.

Much of the conflict over the forests during this decade has been due to the emphasis which different groups have placed on the varied benefits obtainable from them, and forest managers have often been accused of being too insensitive to changing demands... (Bachelard 1979)

The emphasis on forest products is exemplified in such books as Fight for the Forests by the Routleys (1975) in Australia, and Rush to Destruction by Searle (1975) in New Zealand, which present the environmental case against current forest management.

There are copious quantities of additional literature addressed to the validation of the assertions in these books. For

example, Leslie (1976), Rawlinson and Penna (1982), and French (1980, 1983), have all attempted to demonstrate that current forest management is more concerned with wood yields than with conservation/preservation. There are historical documentations of forest exploitation in Australia by Carron (1979), Dargavel (1980), and in Tasmania by Row (1977), Sutton (1980), and Dargavel (1982). There have also been examinations of the content and intent of forestry legislation (Jones 1975; Hoysted 1981), which have in part tried to further demonstrate the primacy of wood production in forest management.

An even greater profusion of literature has been generated which attempts to show the inappropriateness of wood production as the dominant forest use on environmental/biological, socio-economic, and philosophical grounds. The arguments put forward have been summarized in papers such as The Great Forest Sell-Out (Australian Conservation Foundation 1975), and particularly by the Routleys (1975) in The Fight for the Forests.

Papers which deal with the possible environmental/biological implications of forestry operations, in greater detail, include those by Jones (1975, 1982), Ovington and Thistlethwaite (1976), Lake (1974), and Conacher (1975, 1977, 1983). The major detrimental consequences of forestry operations for the environment have been summarized by French (1980) as :

Loss of soil and plant nutrients by erosion and leaching, siltation, increased salinity and eutrophication of waterways with consequent deleterious effects on aquatic organisms and community water supplies; irremediable loss of unique plant associations, together with reduced genetic diversity and stability; threats to

the existence of various birds, animals and insects; the spread of plant diseases and harmful pathogens; and the uncontrollable proliferation of damaging insect species.

On the socio-economic aspects, there are papers by Walter (1976) dealing with the Western Australian situation, by Mc Cuaig and Hoysted (1983) dealing with the Tasmanian situation, and by the Working Group on the Economic and Environmental Aspects of the Export Hardwood Woodchip Industry, Australia (1975) dealing with the general Australian situation.

Forest lands have the potential to provide various products, services, and benefits, such as wood and other forest products, protection of water catchments, habitats for flora and fauna, educational and scientific values, and recreation and refreshment for people (Moulds 1976). In addition, forest management/policy often encompasses a number of social objectives. Included are the maintenance of employment and other linked economic activities (such as community stability), economic development and regional growth, and the maintenance of professional and/or institutional credibility (Waggener 1982)

Unfortunately, "maximum benefits from all uses simultaneously are physical and biological impossibilities" (Senate Standing Committee on Science and the Environment, Australia 1977). The conflict between the provision of wood and non-wood values requires tradeoffs, as exemplified in the conflicts between wood supply and water supply from a forested catchment. Compromise, or the setting of priorities, is necessary if water and/or wood yields are expected from such an area,

since the degree of wood extraction affects both the water quality and quantity obtained from the catchment.

The effects of roading and timber harvesting operations on physical, chemical, and bacterial water quality will vary widely depending on the type of timber harvesting operation, the prescriptions used for catchment protection, the degree of disturbance resulting from the roading and timber harvesting, the resistance of the soil to erosion, the rate of recovery of vegetation, and weather patterns. (Melbourne and Metropolitan Board of Works 1980)

In one experiment where 88% of the old-growth forest was clearfelled and regenerated the annual streamflow doubled in the first year after the clearfelling and regeneration (Melbourne Metropolitan Board Of Works 1980).

The Forestry Commission in Tasmania, like many resource management instrumentalities, was set up by the State Government to pursue narrowly defined objectives. Initially, the Forestry Commission was given a mandate to manage the forests under its control for wood production (Environmental Law Reform Group 1975). The requirements for management, in this earlier period (1920s to 1950s) when the Commissions' operations were primarily concerned with wood production and the benefits which accrued from this production, presented few areas of conflict.

The present means of implementing sustained yield had its genesis and development within this type of vertically integrated management scheme (that is, where the principal aim was to give maximum sustainable yield of timber). However, societal values and expectations have changed markedly from those of feudal or mercantilist Germany

where the concept of sustained yield was developed. A result of this change in values has been that forest management has extended its management objectives beyond the objective of wood production to incorporate non-wood values. Both sustained yield and multiple use are now being promoted as the basic principles of forest management (Australian Forestry Council 1974). This extension of objectives has also increased the fields of conflict for forest management. Decisions need to be made on the priorities and mixture of desired resources sought, as illustrated in the example above of the water catchment area.

These decisions are ultimately dependent upon the relative values placed upon the desired commodities. Yet, neither the objectives of sustained yield or multiple use are presently well-enough defined or understood to enable rational decisions to be made. As the Senate Committee on Science and the Environment (1977) noted about the evidence of witnesses, "there is widespread support for the concept of multiple use of forest, but (there is) ... considerable variation in each witness's interpretation". Further, there has been little questioning of the capability of sustained yield management to incorporate the concept of multiple use (Stocker 1977).

Those few papers which have questioned sustained yield have tended to concentrate on whether the present cutting rates are exceeding the estimated sustained yield level (such as Rawlinson 1980; Jackson 1985; Forest Action Network 1985). As Rawlinson and Penna (1982) noted, however, "most wood availability estimates on which sustained yield implementation relies ... [have not included any] ...

detailing of criteria or assumptions on which they were based".

Even the cursory look represented by the references to the background material presented here would suggest it is vitally important to examine critically the methodology of this cornerstone of forest management. There would appear to be areas of conflict between a method which was originally developed to provide for continuous timber supplies and the extension of that method to provide for multiple values, given the incompatibility of some wood and non-wood values.

1.3 Area To Be Examined

It must be emphasised that the study presented in the following pages does not attempt to determine the accuracy or otherwise of present allowable cut estimates or whether forestry operations are cutting within these limits. Rather, the study attempts to determine the capacity of the present means of implementing sustained yield management to provide for non-wood objectives in forest management.

The following two forest management objectives are the foci of this study : the maintenance of forest productivity, and the provision and/or maintenance of adequate levels of non-wood outputs. These two objectives have received the greatest attention from the critics of forest management, since they believe them to be inadequately provided for in present operations. No Australian studies, however, appear to have examined these objectives in the context of the present means of implementing sustained yield. While the study focuses on the problems

associated with sustained yield, the purpose is not to denigrate the concept of sustained yield per se. Rather, it is hoped that the study, by setting down the limitations of sustained yield management to cater for non-wood values, can be used as a potential aid in the improvement of management practices.

The methods for examining these objectives also need to be carefully defined if clarity and perspective are to be retained. Clawson (1975) has suggested a framework of five criteria for analysing the objectives of forest policy. These are : physical and biological feasibility and consequences, economic efficiency, economic equity, social or cultural acceptability, and operational or administrative practicality.

This framework for analysis was later adopted by Waggener (1982) when considering acceptable criteria for comparing sustained yield alternatives. Waggener went further and depicted the dimensions of the interactions between policy objectives and policy analysis, which are shown in Figure 1.1. The two crosses in Figure 1.1 indicate the two forest management objectives, on the vertical axes, to be examined in the present study, namely, maintenance of forest productivity, and provision of and/or maintenance of adequate levels of non timber outputs. Of the criteria listed by Clawson and later adopted by Waggener, all of which are labelled policy dimensions in Figure 1.1, the dimension of biological and technical capability* was chosen as the

* Under the heading of "biological and technical capability" is included the capability of sustained yield implementation to take into account the ecological, practical, and physical limitations of the forest ecosystem.

Figure 1.1

The Areas of Interaction Between Policy Objectives And Policy Analysis which will be emphasised in the study

Note :

The Format of this figure was taken from that presented In Waggener, T.R., 1982; What are Acceptable Criteria For Comparing Sustained Yield Alternatives, pp. 131-140, In: Le Master, D.C., Baumgautner, D.M., and Adams, D. (eds), Sustained Yield : Proceedings of a Symposium; Pullman, Washington.

POSSIBLE SUSTAINED YIELD OBJECTIVES POLICY DIMENSIONS	MAINTENANCE OF FOREST PRODUCTIVITY	MAINTENANCE OF EMPLOYMENT AND OTHER LIMITED ECONOMIC ACTIVITIES (STABILITY)	PROVISION OF CONTINUOUS WOOD PRODUCTS OUTPUT	PROVISION OF AND/ OR MAINTENANCE OF ADEQUATE LEVELS OF NON TIMBER OUTPUTS	POLITICAL SUPPORT FOR PROFESSIONAL FORESTRY	MAINTENANCE OF PROFESSIONAL AND/OR INSTITUTIONAL CREDIBILITY AND IDENTITY	ECONOMIC DEVELOPMENT AND REGIONAL GROWTH
BIOLOGICAL AND TECHNICAL CAPABILITY	X			X			
ECONOMIC EFFICIENCY							
ECONOMIC EQUITY							
SOCIAL/ CULTURAL ACCEPTABILITY							
POLITICAL/ ADMINISTRATIVE PRACTICALITY							

criterion for evaluation of the two objectives. The choice of this criterion was made along similar lines to that of the two objectives chosen. There is a larger wealth of background information concerning the biological and technical aspects of forest management than exists for the other criteria. This allows the examination to be carried out in greater depth than would be possible with the other criteria.

1.4 Method Of Examination

A case study of sustained yield management in the Southern Forests of Tasmania is presented in this report for the purposes of pursuing the proposed examination. This particular forest area was chosen for a number of reasons. The Southern Forests were the first significant forest area of the State to have a Working Plan. Further, the three generations of Working Plans for the State Forests in southern Tasmania which have been compiled (Forestry Commission, Tasmania 1959, 1974, 1983a), represent the best documentation of prepared sustained yield management plans available for any part of Tasmania's forests.

Within the boundaries of the Southern Forests, there are a number of ongoing areas of conflict between biological/environmental and forestry objectives. The means used by present management in resolving these conflicts will provide a practical demonstration of the sensitivity of sustained yield management techniques to cope with conflicting demands. The conflicts are associated with the presence of a highly sensitive plant community (rainforests) within the commercial

eucalypt forests, and include land-use disputes arising out of the conflict between wood production and conservation/recreational objectives.

Tasmania's native eucalypt forests represent a significant proportion of Australia's native wood resource, and, with the industries based upon it, are major contributors to the Tasmanian economy (Lawrence 1978; Callaghan 1977). Due to the competition between States to attract wood industries, the eucalypt forests of Tasmania, of which the Southern Forests are a significant proportion, are heavily committed to wood production. Because wood production has such prominence in the Southern Forests the pressure to solely concentrate on wood production is likely to strain the capacity of management to provide for non-wood values. Thus, the Southern Forests should be a good test case of the ability of sustained yield management to incorporate multiple use values.

The thesis presents the study in the following format. Chapter 2 gives an account of past and present day meanings, methods, and principles of the objectives and of the implementation of sustained yield management. This general introduction to the principles and theory of sustained yield draws heavily on texts from the Northern Hemisphere out of necessity, since there is a paucity of published Australian material on the subject.

In the next chapter, Chapter 3, a brief history of past policy and management of Crown forests in Tasmania is given. This is of major importance since present and future management policy/plans cannot be

divorced from those of the past, which often limit and/or dictate the direction of present and future plans. This chapter allows the case study area to be seen in the State setting. It also allows more general conclusions about sustained yield management to be drawn for the State.

Chapters 4 and 5 are the core chapters of the study. In Chapter 4, the current system of sustained yield management practised in the Southern Forests is documented. In particular, the assumptions and criteria used in forming sustained yield estimates are clearly defined.

Chapter 5 leads on from the previous chapter by determining how each of the assumptions documented in Chapter 4 potentially constrains management's ability to incorporate non-wood values into its planning process. A significant part of the analysis in this chapter draws upon diverse, but at times scant, ecological data relating to the effects of forest management.

Finally, in Chapter 6 there is general discussion and a summary of the thesis findings on the compatibility between the traditional principles of sustained yield and the multiple-use concept. Some suggestions are made which could help the integration of sustained yield and multiple use concepts in forest management.

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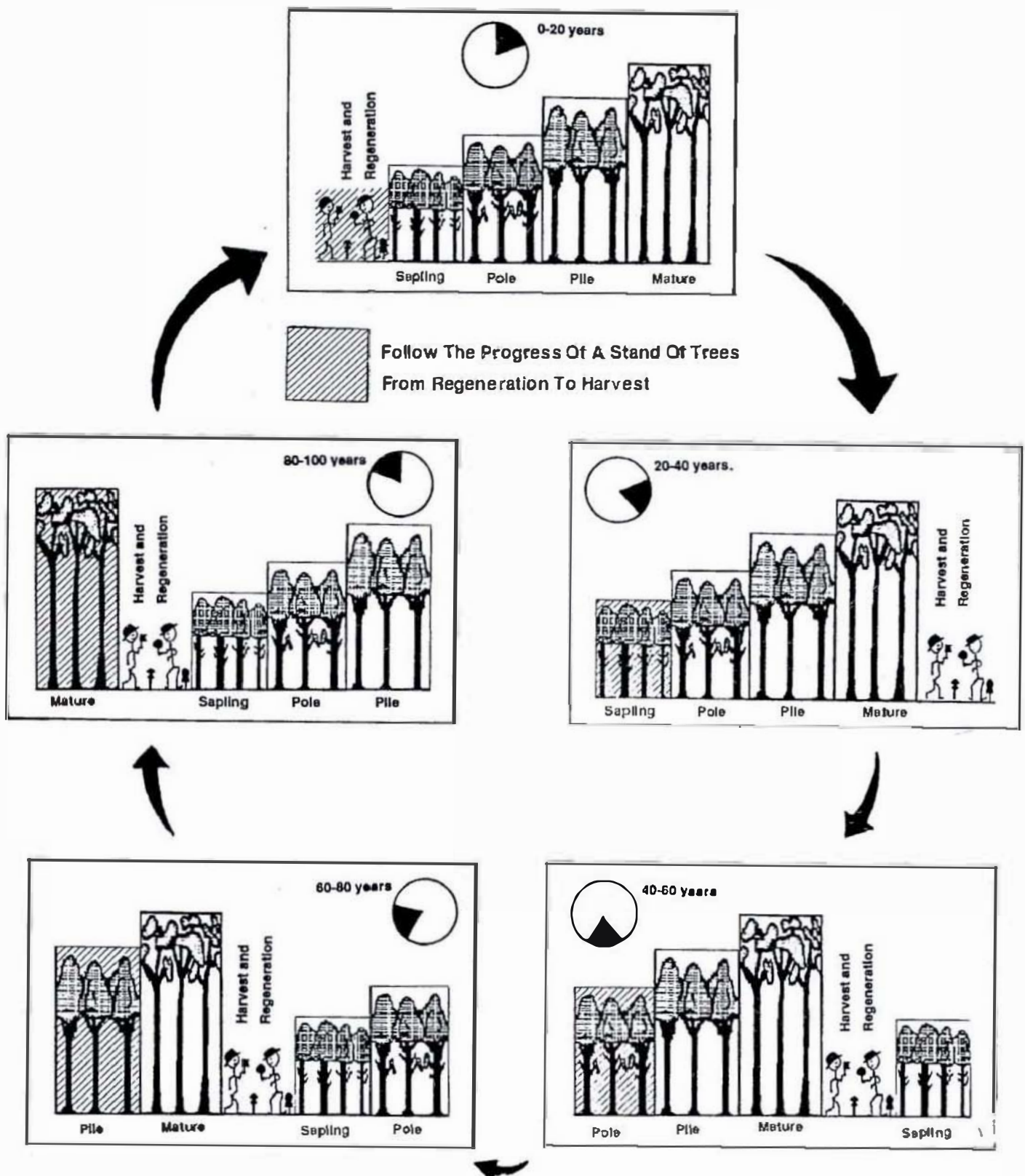
CHAPTER TWO : SUSTAINED YIELD AS A GUIDING CONCEPT IN FORESTRY

2.1 Development of the Sustained Yield Concept

Policy objectives for sustained yield have changed gradually over time, with changes in social, economic, and political conditions. Definitions of sustained yield have changed with these shifts in policy objectives (Lee 1983). Initially, the definition, at the very beginning of forestry management in Europe, was a simple one where timber harvest was equated to the current rate of forest growth. The objective of this system was to prevent overexploitation of timber resources, ensuring the continuity of future timber supplies.

The technique used in implementing sustained yield in this system of management had as its foundation the ideal or theoretical 'normal' forest. A simplified representation of this traditional theory of sustained yield management in a normal forest is given in Figure 2.1. "In the normal forest the annual final yield is represented by the volume of the oldest age graduation" (Thomson and Jerram 1938), labelled in Figure 2.1 as 'mature' forest. The progressive spread of the age graduations in the 'normal forest' is such that, if regeneration takes place immediately after harvesting, there will always be, every year, a stand at the right rotation age (100 years in the diagram), ready to be harvested and yielding the same volume as the previous year.

The inadequacies of this appealingly simple management method

Figure 2.1**Sustained Yield Management in a "Normal" Forest**

(Source : Adapted from Underwood, R.J., 1983; Sustaining the Yield : How Do Ideals Match the Realities of Forest Management in Western Australia, Forest Focus 30, 3-14.)

became apparent, however, with the spread of its use from the regulated or near regulated forests of Europe to other regions of the world, such as the United States and Australia, where substantial areas of the wood resource existed as old-growth forest. While old-growth forests have considerable standing volumes of wood, they have little or no net accumulative growth. Limiting the harvest to this small amount of growth, as the above management method dictates, did not make much sense. After realising this, forest management began to focus on regulating the growing stock, thus taking into account the silvicultural condition of the forests. Annual yield then became a function not only of growth increment of immature stands but also of an orderly liquidation of the forests beyond rotation age (Clawson and Sedjo 1983).

The following paragraphs document the development of sustained yield management, as it applied to forests with significant old-growth stands, in the United States. There exists a far more clearly defined and better documented history of sustained yield management for the United States than exists for Australia. The similarities in current sustained yield management and the age structure of the forest resource between the United States and Australia make the history of United States sustained yield management helpful in understanding the development of sustained yield management in this country.

With the coming of the Great Depression of the 1930s in the United States and the resultant pressure to shift forest management policy towards creating greater community stability within the forest products sector, sustained yield came to be thought of in terms of an

even-flow of timber. The plan was to facilitate the stabilization of communities, based on opportunities for employment. Emphasis was placed more on evenness of harvest than on any regulation of the growing stock, that is, cutting in a manner so as to produce a regulated or near 'normal' forest at the earliest practicable time (Clepper 1971).

This was in a period when there was little forest resource data upon which to estimate allowable harvest levels. A result was that harvest levels were based more on demand and past levels of harvest than on any informed sustained yield considerations. But, as a more complete data base was compiled and better analysis and prediction of timber yields could be made, it became apparent that the level of harvest could not be maintained. The Forest Service then decided to make a harvest reduction which would be consistent with an even-flow policy. This became known as a non-declining even-flow policy (Parry, Vaux, and Dennis 1983).

The non-declining refinement applied to the liquidation of old growth stands and was designed to prevent a gap from occurring when the shift would take place, decades or centuries into the future, to second growth stands. This provision established the practice of liquidating the old forest according to the growth rate of the new one. (Behan 1978)

A similar situation, involving decreasing sawlog harvest levels, has been occurring in the forests of Tasmania during the last decade, as the Forestry Commission compiles a better data base from which to work (see Walker 1982; Harries 1985).

2.2 Defining Sustained Yield

One of the most interesting features of sustained yield, as a forestry practice, is the complexity associated with its meaning. There is no universal definition of sustained yield. (Lee 1983)

Various authors, in attempting to define the current meaning of sustained yield in forest management, have used such words or phrases as "ambiguous" (Le Master et al. 1982), "a virtual wilderness of meanings" (Lee 1982), "a generic concept" (Hyde 1980), "slippery" (Behan 1978), "beguiling" (Behan 1978), "regarded as something of a general panacea" (Davis 1966), "a slogan" (Waggener 1978), "a doctrine of faith" (Underwood 1983), "intuitively appealing" (Clawson and Sedjo 1983), and "a guiding philosophy" (Brown and Cardner 1977): The task of definition is clearly not an easy one in this case.

One reason, advanced by Waggener (1982), is that many people become confused as to whether sustained yield is an objective of forest management or the means of achieving certain objectives.

Most analyses of sustained yield would lead one to conclude that sustained yield is a policy objective -- that is, that achieving sustained yield IS the objective and that resource management is (or should be) geared to achieving that particular version of sustained yield as a policy. (Waggener 1982)

Thus, sustained yield is often seen or thought of as a goal or objective (see Stankey 1976). Adoption of this position often results in discussions about sustained yield stagnating at the level of mere generalities, with each person having his or her own implicit ideas as to what objectives are engendered in sustained yield, but not being sure or even knowing whether they coincide with the views of other

participants in the discussion. Policy objectives, not being explicitly defined, remain murky, and unsure, hidden behind the veil of that appealing, rhetorical doctrine, sustained yield. The choice of means to implement sustained yield management goes unquestioned as to their suitability or as to possible pitfalls.

Yet, upon closer examination, it is not the achievement of sustained yield in itself that is desired but, rather, the implicit outcomes that are assumed to eventuate from the achievement of sustained yield. Thus, if clarity and better understanding of sustained yield is to be achieved, the meaning of sustained yield at any one time and place should be defined more in terms of specific plans of operation which will be used to achieve stated objectives than in confusing generalities.

Those objectives which sustained yield management are meant to achieve, though, first need to be explicitly defined before any such definition of sustained yield can be made. The following section attempts to follow this path by first looking at what objectives are currently encompassed by sustained yield, both in the U.S.A. and Australia, and how the achievement of those objectives is attempted in terms of management.

2.3 Present-day Objectives and Means of Implementing Sustained Yield

Of late, with the growing environmental criticism of forest management, sustained yield definitions have begun to incorporate, for

the first time, outputs of various other renewable resources over and above timber resources. This move was embodied in law in the United States with the adoption of the Multiple Use-Sustained Yield Act of 1960. Throughout all of the changes to sustained yield up until that point, the aim of sustained yield management retained a focus on maximizing wood production, given a certain level of management intensity (Behan 1978).

Waggener (1982), from an examination of forest policy discussions in the United States, has suggested that there were seven main objectives reflected. The following list gives the seven objectives noted by Waggener (1982) and adds a brief explanation of the thesis author's understanding of each.

1. **Maintenance of forest productivity** : maintaining the physical and biological capability of the land base to produce a continuous forest crop.
2. **Provision of continuous wood products outputs** : the classical objective assumed for sustained yield policies.
3. **Maintenance of employment and other linked economic activities (stability)** : providing for the continuity of economic activities linked to the harvesting, and the harvest, of wood.
4. **Provision of and/or maintenance of adequate levels of non-timber forest resources outputs** : providing those tangible and non-tangible values desired by society other than the wood resource.
5. **Political support of professional forestry** : sustained yield was/is used as a focal point for generating a political consensus.
6. **Maintenance of professional and/or institutional credibility** : sustained yield gives the foresters a sense of identity, need, and recognised function.
7. **Economic development and regional growth** : sustained yield is used as an instrument to further social income and employment objectives.

An examination, by the thesis author, of the stated objectives

of forest management for the Southern Forests of Tasmania found that at least five of the above objectives are included. Only political support of professional forestry and maintenance of professional and/or institutional credibility are not overtly referred to in the objectives of management for the Southern Forests (which are presented in Chapter 4).

The objectives noted by Waggener are reflected in the definition of sustained yield that Clawson and Sedjo (1983) suggest is being used, essentially, in all current standard forestry texts in the United States, and in other economically developed countries. The following quotation from Clawson and Sedjo (1983) expresses that definition :

Sustained-yield of the several products and services means the achievement and maintenance in perpetuity of high level annual or regular periodic output of the various renewable resources without impairment of the productivity of the land.

To find a current definition which originates from the Tasmanian scene is quite a difficult task, as "... no Australian forestry act defines these two principles [sustained yield and multiple use] or makes it mandatory that they be practised" (Rawlinson and Penna 1982). The following quotation is one of the very few instances of discussion of the concept of sustainable yield in the literature of Tasmanian origin :

Sustainable yield is the quantity of a resource which can be harvested over time while allowing for a continuous future yield of the resource.

There is no single measure of sustainable yield for any forest area. The yield depends completely on the age at harvest (rotation length) and standards of

utilization. (Tasmanian Woodchip Export Study Group 1985)

While the Tasmanian Forestry Commission espouses the ideal of incorporating multiple use in its management, the above quote, for which it is in part responsible*, gives a much more restricted definition of sustained yield than Clawson and Sedjo (1983), concentrating on the wood resource. It also assumes that sustained yield is an objective to be sought and that it is the forest manager's role to determine which means is to be used to achieve sustained yield, as is witnessed in the following quote from the Tasmanian Woodchip Export Study Group (1985) :

The challenge for the forest manager is to determine the rate at which the old growth forest should be harvested and replaced with vigorously growing forest.

The present basic theory of implementing sustained yield management in both the U.S. and Tasmania is through a policy of non-declining even-flow**. In this scheme, rotation (harvest) age is at about the time when mean annual increment reaches its maximum level*** (approximately at 80-90 years in the Southern Forests of Tasmania).

* The Forestry Commission was co-author, along with Associated Pulp and Paper Mills, Forest Resources, and Tasmanian Pulp and Forest Holdings Ltd in producing the Environmental Impact Statement on Tasmanian Woodchip Exports Beyond 1988.

** Non-declining even-flow is a documented policy of the U.S. Forest Service. From an examination, by the author, of the Tasmanian Forestry Commission's predicted timber flow for the Southern Forests (data presented in Chapter 4), the timber flow pattern follows that of a non-declining even-flow regime.

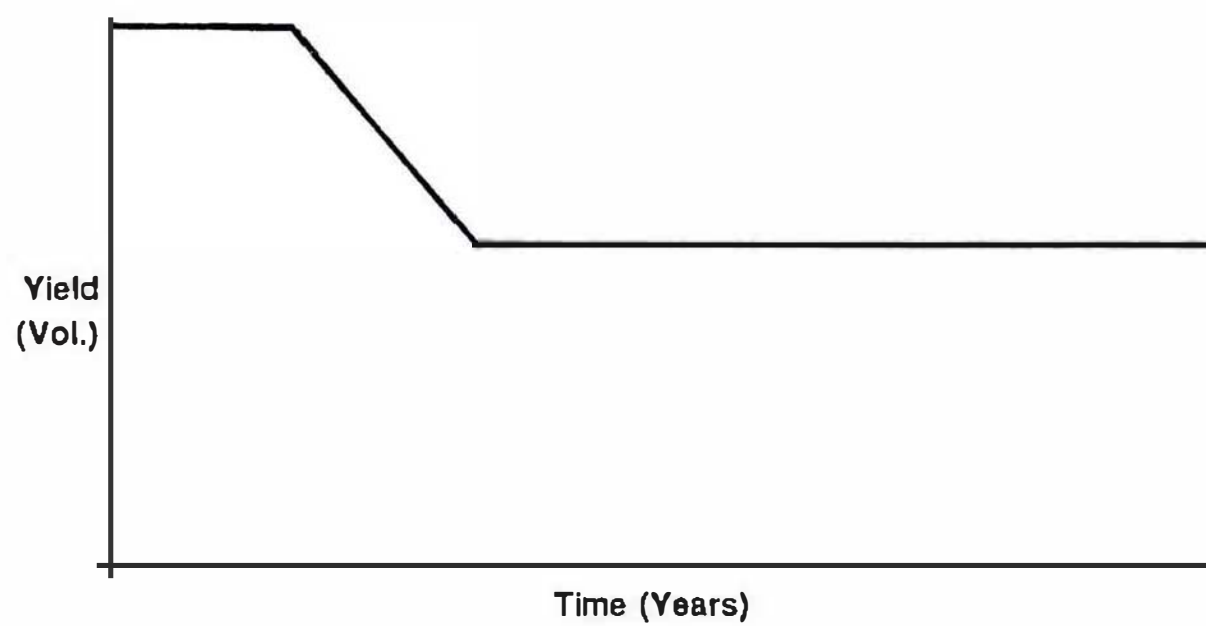
*** Mean annual increment is the average annual incremental growth of the forest, expressed in terms of volume, which can be obtained by dividing the total volume by the age.

Figure 2.2 shows a graphical representation of the wood flow over time from such a scheme. The final harvest volumes/year will be equal to or greater than at the start. This particular scheme has a greater deal of flexibility than an even-flow regime which needs a very rigid balance in such parameters as age class distribution. A much more detailed description of the present method of sustained yield management in the Southern Forests of Tasmania is given in Chapter 4.

If the rotation age was to drop below the rotation age for the even-flow regime, the result would be a more intensive form of management which would give greater volumes of wood for the first rotation period, followed by a decline in the volume harvested after this period. Figure 2.3 gives a diagrammatic representation of the flow from such a regime.

2.4 Conclusion

The above theories of sustained yield management show a great number of practical inadequacies. They do not allow for any change in land base or level of forest management intensity, while they also do not give any consideration as to what forest area or intensity of management would be needed to fulfil desired objectives, such as community stability. They give no information relating to how the transition between a non-regulated and a regulated forest is to be achieved. They do not allow for external catastrophic factors such as wildfire or disease, or, indeed, any deviation from the even-flow of wood to occur (Mc Kinnell 1983). They also assume an accurate and

Figure 2.2**Non-Declining Evenflow**Figure 2.3**Declining Evenflow**

comprehensive forest inventory.

The emphasis of the traditional technique of sustained yield management has been placed upon the timing and extent of harvesting. This technique has received little public attention, hiding behind the illdefined ideal of sustained yield. A forest resource does not have an intrinsic sustained yield level. Sustained yield estimates should not be used as the dividing point between good and bad management. These estimates represent an attempt by man to control his forestry operations for the benefit of present and future generations and as such the estimate is a guide, not a production target. The points noted in the last two paragraphs are expanded and developed upon in Chapter 4 and in Chapter 5 where the emphasis is placed on the effects that such characteristics of sustained yield management have on the provision of non-wood values.

Each application of sustained yield management is unique in means of implementation, since the means of implementation is dependent upon past policies, political and administrative circumstances, specific forest area, and management, not on theoretical considerations alone. In the following chapter a history of past forest policy and management is given in order to show how present management has evolved in Tasmania, and to gain a better understanding of the present direction of sustained yield management in Tasmania.

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CHAPTER THREE : A HISTORY OF CROWN FOREST MANAGEMENT POLICIES IN TASMANIA

3.1 Introduction

The aim of this chapter is to outline the evolution of forest policy and management in Tasmania. This discussion enables a better grasp of present forest management to be gained. The broad background details given in this outline form part of the background material necessary for the understanding of present management in one particular area of the Crown forests, as presented in Chapter Four. Particular emphasis is placed upon the role that sustained yield plays in policy and management. Present management cannot be divorced from past policy and management. Past policy and management is the foundation upon which present management has developed and can be viewed as a constraint on future management.

Tasmania has the highest concentration of forest resources of all the Australian States. Approximately 2 779 000 ha, or 40% of the total land area of Tasmania, is forested (Australian Bureau of Statistics 1982). By far the greatest proportion of these forests is dominated by the eucalypts, the most important commercially being E. delegatensis, E. obliqua, and E. regnans. Tasmania has 17% of Australia's high quality eucalypt forests, while comprising less than one percent of the nation's total land mass (Lawrence 1978). It is not surprising that the forest resources of Tasmania have played a major role in its development, nor that, historically, forest policy in Tasmania has given priority to the native hardwood (eucalypt) forests (Senate Standing Committee on Trade and Commerce Inquiry, Australia

1981).

3.2 Mining of the Forests (1803 - 1881)

The true birth of forestry policy/management cannot be said to have taken place in Tasmania until the passing of the Waste Lands Act 1881. Up until this time, forestry practices could be described as uncontrolled exploitation (mining) of the forest resource. Although there were sawmills set up earlier to exploit the Huon Pine resources of the State, the first sawmill established to utilize the native hardwoods began operations in the early 1830s near the present Cascade Brewery in Hobart. This supplied timber for the early settlements.

The government of the day had a policy of deliberately encouraging agricultural expansion by only allowing alienation of Crown land to bona fide agriculturalists. In so doing, the sawmillers were discriminated against, since they had no security of tenure. Little or no thought was given to forest practices by either the government or those exploiting the forest resource.

The Waste Lands Act of 1842 passed by the Imperial Government, concerning the disposal of the Waste Lands of the Crown, reserved to the Crown the right to reserve land for a number of public purposes, but forestry finds no place in the list. Even when control of such land passed to the Tasmanian Parliament, the first Waste Lands Act of 1858 empowered the Governor to reserve land for various public purposes, but again, there is no mention of forestry.

The total lack of thought given by the exploiters of the forest resource is epitomized by the remarks of one sawmiller of the time :

Land is settled to the full extent under the Act, and as a matter of course the best portions of the timber lands are occupied and the "eyes", as it were, picked out. After the area selected has been denuded of its timber....the rent or instalment falls due, and is not paid, shortly after an application is perhaps sent in for another block some distance ahead of the former one...
(Quoted from Kemp 1982)

The general public held two prominent views about the forests (Carron 1979). One was to consider them as impediments to settlement, and the aim was to remove them as quickly and completely as possible. This image of the forests is summarized well in a description quoted by Row (1977) :

On the visitors who came to stay as settlers, (the immense extent of the forest land in Tasmania) made an unfavourable impression, as its significance to them was the cost of clearing land for cultivation. And this impression has flavoured and affected all that has been done in the way of dealing with forest land in the state. Trees have been regarded almost exclusively as impediments to agriculture, and not as possessing any intrinsic value worth consideration.

The other view was to regard the forests as an inexhaustible supply of wood to meet local and, where possible, export needs.

Sawmilling activities boomed during the 1850s, with the discovery of gold in Victoria and the accompanying explosion in the demand for building materials. This led to a great rise in timber production in Tasmania with an accompanying overexploitation of the

accessible sawlog resource. Concern for the depletion of the forest resource started to become apparent at around this time. It led to the first legislative concession to any form of forestry with the amending of the Waste Lands Act in 1865. But it is the Waste Lands Act 1881 which must be regarded as marking the birth of government concern over forestry practices.

3.3 The Birth of Forestry Policy (1881 - 1920)

As mentioned, the drafting of this Act appears to have resulted from the growing concern being shown about the degradation of the forest resource from overcutting. The Act enabled the Governor in Council to reserve Crown land "for the preservation and growth of timber" and to charge a fee for timber getting (Steane 1947). Although this marks the start in principle of government forestry policy, it proved ineffectual in practice. As Row (1977) notes of that period : "Official expression of interests in forestry may be aptly described as tokenism". By the end of June 1886, only 8 reserves had been proclaimed with a total acreage of 51 550 acres (20 860 ha).

Indifference, not ignorance, appears to have been the attitude held during this period towards the degradation of the forest resource that was occurring. In 1885, the State Forest Act was passed which empowered the Governor in Council to appoint a Conservator of Forests. In March 1886, Mr G.S. Perrin was appointed first Conservator of Forests. On his first tour of the State forests, and in the reports resulting from that tour, he notes the enormous amount of illegal

cutting for which no revenue was being taken and the large amount of damage to forest which had been perpetrated. As a visiting English timber expert to Tasmania in the 1900s declared :

...I saw the waste - wilful and ignorant destruction of some of the finest trees which ever existed in any country... I felt really heartsick as I looked at such standing monuments of man's ignorance and folly in destroying or allowing to be destroyed, such a valuable factor in the prosperity of your country and its climate.

On investigation I found that bushfires on the one hand, and wanton and useless ringbarking on the other were the principal causes of this deplorable destruction of such valuable property. (Quoted from Row 1977)

Indiscriminate exploitation of the forest resource continued on into the 1920s. Steane (1947) wrote

In many of his annual reports right up to 1918 - 1919 - the last of his control of state forestry - the Secretary for Lands complained that he has frequently called attention to the need for afforestation and for the better control of forest exploitation, all without practical result.

A major shift in government policy relating to forestry matters occurred in the 1890s, resulting in the Crown Lands Act being amended a number of times. The government adopted the policy of allocating large areas of Crown land for extensive periods of time to individuals and companies in order to attract capital investment and to stabilise industry. This was a shift away from the policy of only encouraging bona fide agriculturalists to one where large proportions of the State were seen as being best used for forestry practices. Row (1980) noted : "Encouragement of large scale foreign investment in the publicly owned forests of Tasmania became the policy of the Braddon Government in 1898".

An extension of this desire to attract foreign investment, and concern for the wastage which was resulting from the expanding sawmilling industry, led the Tasmanian Government in 1914 to bring in an expert to report on the feasibility of pulping eucalypts (Meadows 1982). The report concluded that the eucalypts were unsuitable, in the circumstances then existing, for pulp production. However, research carried out elsewhere in Australia a few years later, which found that young eucalypt wood produced better results than mature wood, led the Tasmanian government to once again endeavour to attract large scale capital investment in industries utilizing eucalypt pulp. This eventually resulted in the passing of the Wood-Pulp and Paper Industry Encouragement Act in 1926 which gave exclusive rights to all pulpwood on a large concession area based around Burnie to Associated Pulp and Paper Mills (A.P.P.M.).

3.4 The Forestry Department (1920 - 1947)

The Forestry Act 1920 was the next major legislative initiative taken by the Government concerning forestry matters. This Act provided for the creation of an independent Forestry Department which had exclusive control and management of :

1. all matters of forestry policy;
2. all State forests and timber reserves, and, subject as hereinafter mentioned, the forest products of other Crown lands;
3. the planting or thinning of forests, and the making, laying out, and maintaining of plantations and nurseries on Crown lands, and the distribution and disposal of forest products therefrom;

4. the granting of all permits, licenses, and exclusive forest permits under this Act;
 5. the enforcement of the conditions of timber concessions, timber leases, exclusive forest permits, licenses, and occupation permits under this Act;
 6. the collection and recovery of all rents, fees, royalties, charges, and revenues of the Department;
 7. the administration of this Act generally.
- (Parliament, Tasmania 1920)

Although long-term forestry management had been espoused as far back as 1889 by Perrin, the first Conservator of Forests in Tasmania, it was not until this Act was passed and a number of professionally trained foresters were brought in that any long-term forest management policy was adopted. This included management of the forests "to give within economic limits the maximum sustained yield" (Steane 1935). The idea was based upon the European experience with regulated, even-aged forests, and was thought of as follows :

It [The State's forest resources] can be exploited on conservative lines in a way so as to yield a succession of crops and by having a complete series of age classes it is possible to harvest a mature crop each year. (Steane 1935)

Another of the policies was to provide for a continuity of supplies to the existing industries. The reason given for this policy was :

[Continuity of industry is] ... desirable by reason of employment because stability of employment in any neighbourhood makes for permanent settlement and higher standards of social welfare and citizenship. (Steane 1935)

These management ideals took a back seat, however, to the more

pragmatic aim of trying to maintain the viability of the timber industry during the Great Depression. The result was that forestry management implementation and policing of forestry operations was virtually non-existent. The Department conducted its activities in such a way as to impose as little an impediment to viable forest operations as possible (Steane 1947).

Another reason why the fledgling Department had very little effect on forestry operations during the 1920s and 1930s was lack of staff and revenue. In 1923, the permanent staff of the Department consisted of the Conservator, the Chief Inspector, a Working Plans officer, four district foresters and a typist (Steane 1947). This meant that little attention was paid towards forest protection or improvement. To cope with the increasing demands for timber, the department looked towards protection from fire, silvicultural treatment, and further dedication of forested land to State Forest as the means of overcoming this problem, rather than restricting output.

By the late 1930s and 1940s, the Department was beginning to gain control over forestry operations and to implement forestry management policy. Sawmillers were required to obtain their supplies from coupes delineated and regulated by the district foresters according to management policy. Assessment of the forest resource, so vitally necessary for the proper management of the forests, had begun. A number of small areas now had Working Plans. An organized fire protection system had been initiated. By 1947, the permanent staff of the Forestry Department had been built up to a total of 146 permanent and temporary staff (Steane 1947).

The government continued to maintain a policy of attempting to attract large-scale foreign investment in forest resources during this period. This led to two large sales of Crown timber on concession areas at low royalties for pulp and paper industries at Burnie, in the Northwest of the State, and Boyer, in the Derwent Valley, in the 1930s. An examination of the contents, rights, and obligations assigned by the State to the licensee of the Burnie concession area indicate the government's attitude towards the forest resource. The Act relating to the Burnie concession area granted exclusive rights to cut and remove any pulpwood and milling timber contained within the concession boundaries. A Working Plan was not required for most of the concession area, royalties were fixed at a very low rate, water requirements of the company were to be met without charge, and there were also financial incentives offered. The company, in turn, was obliged to expend a certain sum of money in the establishment of the industry by a specified time (Hoysted 1981). Thus, the government was prepared to offer large areas of prime forest and to carry out forest management (road building and maintenance, fire suppression, administration, and regeneration) for little more than a specified amount of investment in the establishment of a pulp and paper mill by the company.

The next major legislative development to affect forestry was the establishment of the Forestry Commission in 1946. The Commission took over the administration of the Forestry Department. This was brought about by allegations in two reports which alleged corruption and irregularities in the dealings of the department with private timber interests (Kessel 1945). These reports led to a Royal Commission

into the activities of the Department. The result was that the government amended the Forestry Act in 1946, giving full control of forestry matters to the incorporated Forestry Commission.

3.5 Development of the Forestry Commission (1947 -)

The two decades following the formation of the Forestry Commission saw a large-scale increase in forest service activities. This expansion was instigated by the government of the day to gain public confidence and, partly, as a scheme to provide employment opportunities for ex-servicemen returning from World War II (Sutton 1980).

The Commission saw the outstanding needs of the State with respect to the forests at that time as an inventory of the resource, the dedication of the best forest land, roading, fire protection, and the establishment of softwood plantations (Carron 1980). Although the employment creation scheme was not particularly successful, the increased expenditure granted to the Commission allowed it to expand its road construction programme, begin a systematic aerial survey of Tasmania's forest resource, and gain firmer control over forestry operations.

A rapid increase in timber production, in the post-war years, and severe fires in the early 1950s awakened private and public concern over the future availability of sawlogs for the State's needs. As a result, in 1952, a Board of Inquiry was set up to investigate timber

prices, sawlog production, and the capacity of the State Forests to meet future demands. In its report, the Board recommended continuance of the policy of conserving timber to meet the requirements of the State : "the Commission should refrain from making new sales of Crown land timber except on the assurance that the timber cut therefrom will be supplied by the millers concerned to meet local needs" (Parliament, Tasmania 1952). The reasons for this shortage were stated thus "60 - 100 years of sawmilling without regard to reafforestation and the clearing of land for settlement have resulted in the cutting-out of the more easily accessible forests"(Parliament, Tasmania 1952).

Despite the overexploitation mentioned, the commitments to industry by the Crown presupposed considerable new dedications of Crown land to State Forest (Select Committee of the Legislative Council, Tasmania 1972). However, during the 1950s and 1960s, there was increasing resistance to further dedication. Initially, this resistance was from mining interests, and then later from the Lands Department (Cunningham 1982). The Lands Department resisted dedication of Crown Land subject to grazing leases to State Forest, because it lost control over the grazing lease to the Forestry Commission. During this period the government was still actively trying to promote further investment in the pulp and paper industry by offering exclusive rights to pulpwood in large reserve areas.

Apart from the government's decision to try to attract further capital investment in the forest industry by offering large resources of pulpwood at cheap prices, the Commission stated that it had another reason for trying to attract major pulpwood industries to the State.

Due to economic constraints, the Commission restricted its regeneration program to forest areas which had had both sawlog and pulpwood harvested from it. As a result, the Commission was concerned at the large areas of the State's forests which had been left in a "degenerate" state after the sawlog component had been cut out (Select Committee of the Legislative Council, Tasmania 1972). In 1959, the Huon Valley Pulp and Paper Industry Act was passed granting concessional rights of the Southern Forests to Australian Paper Manufacturers (A.P.M.), who proposed to establish a semi-chemical pulp mill at Geeveston.

The year 1959 also saw a major change in management policy and practice. A Select Committee of the Legislative Council reported on the regeneration of State Forest, at the start of 1959. The Committee examined whether "in the commercial exploitation of the indigenous eucalypt forests, proper measures were being taken to replace the original and mature stands as they are harvested, and so provide an adequate and increasing yield for the future" (Select Committee of the Legislative Council, Tasmania 1959). The Committee found that no real attempt to plan regeneration of worked over areas had occurred. The reasons given were the lack of knowledge of the forest resource and the nature of sawmilling operations. While it found that natural regeneration in the drier open forests had occurred satisfactorily, regeneration in the more important wetter, tall eucalypt, forests had not naturally followed to a satisfactory standard (Gilbert and Cunningham 1972).

The recommendation of the Committee to pursue a vigorous

policy of regeneration, based on fresh research results concerning regeneration techniques, was adopted by the Commission within a year. The Committee also recommended a change in emphasis in forestry policy. "The prime function of forestry should now be the growing and protection of new forests and the greatest possible utilization of the remaining mature stands" (Select Committee of the Legislative Council, Tasmania 1959). This was a shift from being primarily concerned with attempting to regulate forestry activity without undue hindrance, to a situation closer to that of sustained yield regulation where key limitations and characteristics of the forest resource are recognised. The other major recommendation was to establish Pinus radiata plantations to fill projected shortfalls in hardwood sawlog in the years ahead.

However, due to economic considerations, regeneration operations were restricted to those areas where integrated logging* occurred. No attempt was made to re-establish commercial forest on land previously cut-over for sawlog extraction. The Forestry Commission's policy was "... to reserve standing pulpwood for developing industries in regions where markets appeared likely to be available in a reasonably short time and on areas where sufficient volume of pulpwood remained to allow it to be logged economically in the future" (Select Committee of the Legislative Council, Tasmania 1972).

* Integrated logging involves the harvesting of both sawlog and pulpwood in a single operation.

Regeneration was thus restricted to the A.P.M. reserve area in the South, and also to the north-east and north-west of the State where it was considered that the forests were outside the reasonable range of existing or proposed pulpwood industries. Regeneration of logged forests extended into other areas as pulpwood markets were developed: into the A.P.M. concession area in 1962; into the Burnie (A.P.P.M.) concession area in 1965; into the Wesley Vale concession of A.P.P.M. in 1972; and into the Tasmanian Pulpwood and Forest Holdings (T.P.F.H.) concession area in 1971 (Felton 1976). Concession areas are marked on the map in Figure 3.1.

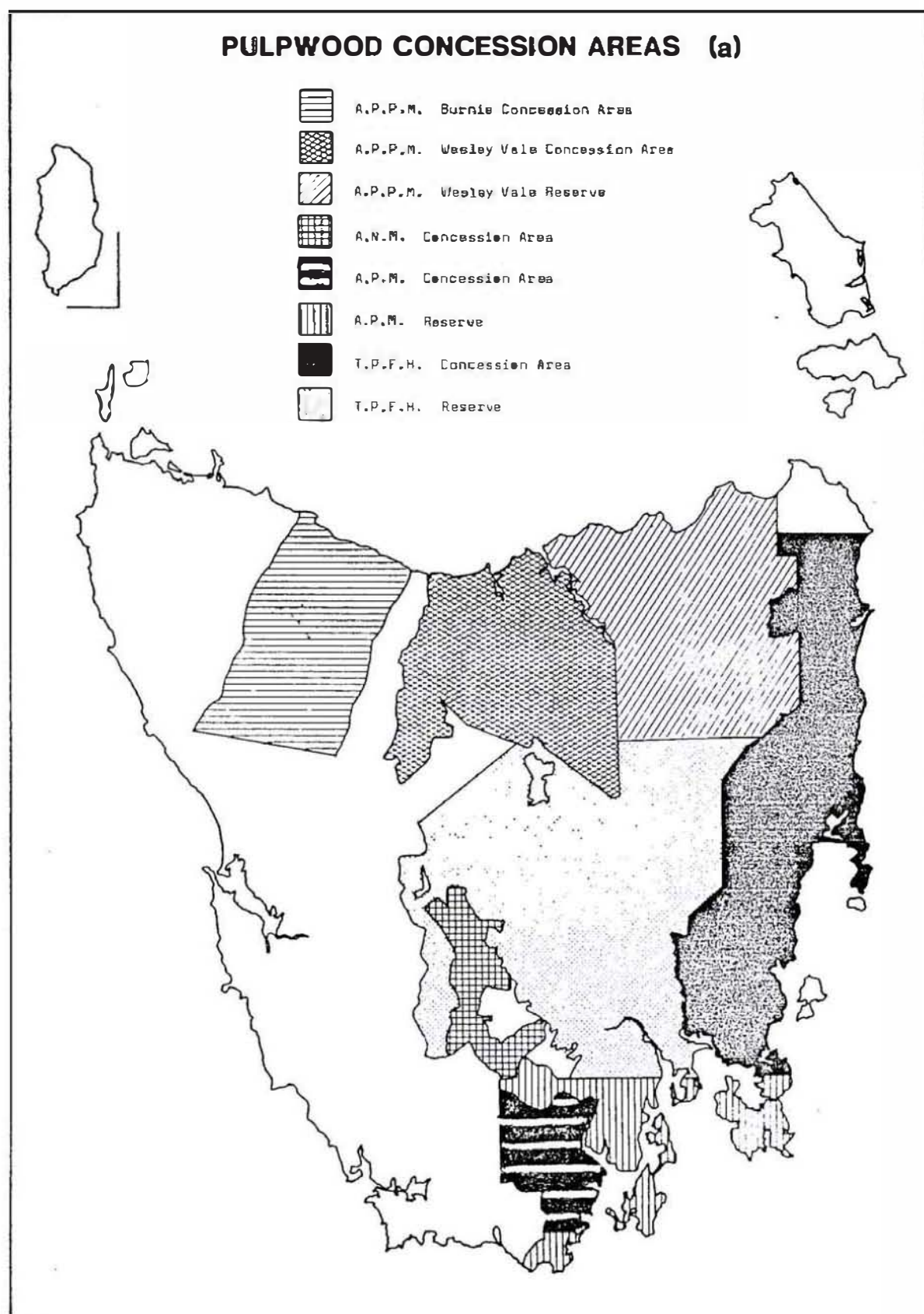
Another important event to occur in 1959 was the gazetting of the Southern Forests Working Plan. As part of the granting of the Concession area to A.P.M., the Commission was responsible for drawing up a Working Plan for the timber reserve. This Working Plan was the first to cover any extensive area of State Forest and was said to be suitable as the model for subsequent plans to cover State Forests elsewhere in Tasmania. The plan states its management objectives as follows :

1. To obtain the maximum economic sustained yield of milling timber and pulpwood as priority uses, and of other forest products as needed in those parts of the state in perpetuity.
 2. To bring the forests to full productivity by progressive steps.
 3. To ensure that the forests supply forest values other than that of timber production (these other benefits, however, are subsidiary to those of wood production).
 4. To obtain a permanent and reasonable distribution of industry throughout the area.
- (Forestry Commission, Tasmania 1974)

Figure 3.1

Forest Concession Areas Granted By Acts Of Parliament To Private Companies in Tasmania

(Source : Australia Bureau of Statistics, 1985; Tasmanian Yearbook, Government Printer, Hobart.)



This Working Plan provides for planning and prescriptions to be detailed in progressive five-year plans of operation, which are revised annually.

The 1960s saw a further expansion of the Commission's activities and of the pulp and paper industries in the State. Acts were passed granting the Wesley Vale concession area to A.P.P.M. in 1961, and a further extension to A.N.M.'s Florentine Valley concession area was granted in 1966. Progress was made by the Commission in instigating better forest resource estimates with the introduction of the Continuous Forest Inventory programme and the adoption of computer facilities to aid storage and processing capacity (Forestry Commission, Tasmania 1966).

However, while these assessment programmes were still in their infancy, further major allocations of the forest resource occurred in the late 1960s and the early 1970s with the licensing of woodchip exports to Japan. At this point, there appears to be a dichotomy in the Commission's policy. On the one hand, it recognised that there was a lack of a complete assessment of the forest areas and the potential of the resource (Forestry Commission, Tasmania 1968), acknowledged as essential knowledge for effective forest management and the establishment of new industries. At the same time, it forged ahead with large new allocations of forest resources to industry. The Commission appeared willing to accept the risk of committing itself to the supply of unsubstantiated resources.

Meanwhile, public criticism of the introduction of export

woodchipping led the Commission to change its stated emphasis in policy from one of wood production towards one where more consideration of non-wood values was given (Institute of Foresters of Australia 1972, 1975). Several legislative changes to the Forestry Act in the 1970s also indicate changes in government attitude brought about by the increased concern being shown for the environment by the public. The Forestry Act 1975 made further provision for the Commission to consult with the Director of Environmental Control on pollution or alteration of the environment. The Forestry Amendment Act 1980 laid out the terms for forest management plans to be prepared for State Forests within Conservation Areas proclaimed under the National Parks and Wildlife Act 1970. The Forestry Amendment Act 1981 provided some financial assistance to landowners to promote the growing of trees for purposes other than wood production.

Because the documentation of management in the Southern Forests presented in the next chapter comes largely from the Working Plan written for that area in 1983, the present historical documentation does not extend beyond the early 1980s. The policies and management priorities of the Commission for the last decade, the 1970s, have been summarized by the Commission to be "the management of the forest estate in perpetuity and the continuation of our renewable resource" (Forestry Commission, Tasmania 1982). Stated management priorities were :

1. The dedication to permanent State Forest of forest land not held as private property, National Park or other reserve. The minimum target of 1 618 000 hectares had been almost fulfilled by the end of the 1970s.
2. The integration of forest harvesting to reduce waste,

improve sawlog harvest and cater for the expanding pulpwood market, along with further forest regeneration programs.

3. The establishment of softwood plantations in areas where large softwood forests could be aggregated.
4. The reinforcement of forest management and harvesting controls to emphasise forest values such as wildlife, natural beauty, public access and water quality.
5. Upgrading of the Commission's functions in administration, research, regeneration programs and staff development and training.
6. Protection of old and new forests from fire, pest, and disease.
(Forestry Commission, Tasmania 1982)

3.6 Summary Overview

The early settlers and governments in Tasmania gave little consideration to the finite and potentially non-renewable nature of the forest resource. The extensiveness of and unfamiliarity with the Tasmanian forests were among the factors which led to this neglect. The consequence was unbridled exploitation of the resource at the more accessible edges, with little or no regard for its regeneration. The land was considered by most as being only useful for agricultural purposes. It was also assumed, apart from the undeniable right of anyone to exploit the resource, that no financial remuneration to the State for the utilization of the resource was applicable. The result was the degradation of the forests and the inevitable overexploitation of the accessible resource.

Concern regarding the possible shortage in supply brought

about by this overexploitation marked the start of the slow and gradual awakening of the public and the government to the need for controlling and managing forestry operations. These initial steps, however, in the late 1800s and the early 1900s, were only of a token nature. Little by way of financial resources or labour were devoted to forestry management. What actions were attempted had no real effect on the chaotic forestry operations being practised at that time.

Although individuals, between the 1850s and 1890s, had drawn attention to the need for forestry management, the concern of the State Government was for general industrial development rather than for the wise use of the forest resource. There was, however, a change in Government policy in the 1890s, which was to have a major influence on forestry in the State. The Government adopted the policy of attracting large-scale, industrial, forest-based development by offering large tracts of Crown forest to private individuals or companies in return for their capital investment in the State. This was a step away from the attitude that the land was only good for agricultural development, but it still maintained the old status quo of expecting little revenue to be received from the use of the resource.

The establishment of a forest service in 1920 saw the introduction of forestry management to Crown forests, if only as a policy ideal. Lack of staff and revenue for the Forestry Department meant that little attention was paid to forestry management in reality. Forest operators continued their practices of old. This situation was also aided by the lack of knowledge of the resource and the harsh economic climate of that time, which forestalled any implementation of

management controls since they were perceived as likely to influence the viability of the forest industries.

The roles which the forest service and the government were to play in the coming decades developed during the 1930s and 1940s. The government continued the process of allocating forest areas to industry for use of the pulpwood resource, while the forest service slowly gained greater influence over sawlog operations and administrative control of forestry operations.

Incomplete knowledge of the extent of the forest resource and the forest service's policy of stabilising existing forest industries, by ensuring continuity of supplies, meant that the role of the service during the 1930s and 1940s was one of aiding and gently guiding wood production, rather than one of managing on a sustained yield basis by regulating and controlling supply. This aid extended to functions such as fire protection, dedication of State Forests, roading, and the planning of cutting. The result was that in good economic times, overexploitation of the accessible sawlog resource often occurred.

Continued expansion of forest service activities and further granting of pulpwood rights to industry by government occurred through the 1950s and 1960s. The most significant change to occur was the adoption by the Forestry Commission of the practice of regenerating all areas of forest where integrated logging occurred. The 1960s also marked the first occasion when the forest service was able to reasonably assess the extent of the forest resource.

Further granting of pulpwood rights to industry, this time for woodchip export, continued on into the early 1970s. However, this time, a slight perturbation arose compared to early grants. There was widespread public concern about the need for these allocations and the possible detrimental effect they might have on the environment. There was also greater concern shown for multiple use of the resource, rather than solely using the forests for wood production.

Like all previous occasions, the government and forest service have responded slowly and incrementally to public pressure. What has been implemented has been described as token (Bowman 1979) or cosmetic (Hoysted 1981). Modes of operation seem to have changed little from the 1890s, when the government's actions in attempting to remedy the rapid degradation of the forests were described in a similar fashion. Wood production and, through it, industrial development are still the prime aims of the government and the management activities carried out by the Forestry Commission.

Having described the broad historical background to forest management policy in Tasmania, the following chapter examines the 1980s management of one sector of Tasmania's State Forests, the Southern Forests. It will be shown that management in accord with sustained yield measures incorporates many unstated assumptions. These assumptions, which hold important implications for many non-wood values, are spelled out systemically in the chapter.

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CHAPTER FOUR : CURRENT IMPLEMENTATION OF SUSTAINED YIELD IN THE SOUTHERN FORESTS

4.1 Introduction

Sustained yield management in the Southern Forests (a term used to cover the whole of the Crown forests in the Australian Paper Manufacturers (A.P.M.) concession; see Figure 4.1, page 59) is a collaborative effort which brings together many specialist skills to form a management plan upon which forestry operations are based. Aerial photograph interpreters produce the forest type maps from which the extent (area) of various eucalypt forests (old-growth and regrowth, stratified into height and density classes) is determined. Mathematicians, statisticians, computer programmers, and technical field staff combine to supply estimates of wood volume increment (quality and quantity of growth) and yield tables, by analysing data from plot samples in the Continuous Forestry Inventory programme. Silviculturists determine the type and level of silvicultural treatment to follow harvesting, which largely determines the future conditions of the forest. Finally, there are the forest planners/managers who compile a Working Plan based on the data supplied by the specialists.

This chapter presents an account of the end result of all the inputs from the specialist fields, the Working Plan. It does not deal with each of the individual specialist fields which have contributed to the plan. Thus, the documentation in this chapter concentrates on how the different specialist fields are integrated, and what assumptions and criteria are used in bringing them together to form the Working

Plan. The assumptions are presented without comment or further analysis in this Chapter. That task is undertaken in Chapter 5. To aid the later analysis, the assumptions presented in this chapter are numbered A1....A7, B1....B6, etcetera, for use as a referencing tool.

Before proceeding, however, it should be noted that the licensee of the Southern Forests concession area, A.P.M., which was granted the sole rights to remove pulpwood from State Forests and other Crown lands in the concession, closed its operations in October 1982. The Forestry Commission is, at present, examining proposals from various private companies to utilize the pulpwood resource, and will be making a decision as to the allocation of that resource in the near future. A.P.M.'s closure does not affect the examination, since this report is largely restricted to the principles used in the plan and not with working figures. Rather, the abrupt cessation of pulpwood forest operations points to the incorrectness of one of the major assumptions used in the implementation of the traditional model of sustained yield, that is, that there will be a continuation of utilization standards for the entire period of the Working Plan.

4.2 Forestry and the Forests in Southern Tasmania

The following descriptions of forestry practices in this chapter are derived from an examination of the Working Plan for the Crown forests in Southern Tasmania 1983, and from discussions with personnel in the Management Division of the Forestry Commission. The State Government has made a decision that a sawlogging industry is to

be fostered in this region. Thus, management plans are aimed at supplying a mixture of both sawlog and pulpwood, since, it is argued, present silvicultural and economic constraints make it necessary to have fully integrated use of the forests, that is, logging of particular stands such that different forest products (sawlogs and pulpwood) are harvested together in a single operation.

The stated objectives of management are :

1. To obtain from the Working Plan area:
 - (a) the maximum possible economic sustainable yield of milling timber and pulpwood;
 - (b) other forest products.
 2. To ensure the area provides, on a continuing basis, other benefits including water, natural, recreational, and other cultural values.
 3. To organise full, and integrated use of the forests managed for wood production.
 4. To organise forest operations to provide continuity of supply to the milling and pulping industries and stable decentralised forest employment.
- (Forestry Commission, Tasmania, 1983)

Of the objectives that sustained yield management generally encompasses (as discussed in Chapter 2), the following are obvious in the Southern Forests management objectives as stated above: maintenance of forest productivity; provision of continuous wood products output; maintenance of employment and other linked economic outcomes like community stability; provision of and or maintenance of adequate levels of non-wood outputs.

Working Plans for the Southern Forests are prepared/revised every ten years. The present Working Plan is the second revision of the original Working Plan. A five-year plan of operations, which includes nomination of and responsibility for areas to be felled and harvested,

planning for the construction and maintenance of roads, silvicultural and fire management works, details of management practices, and standards of operation, is prepared to cover a period of five years ahead. There is also a special forest management plan for the Crown lands within the declared South-West Conservation Area. Wood yields from this area are, however, included in the Southern Forests Working Plan.

The Southern Forests cover an area of approximately 220 000 ha of Crown forest south of Hobart, extending from the Russell/Plenty divide in the north, to the south coast, including Bruny Island, the Tasman and Forestier peninsulas, and extending westwards to a line roughly joining Mt Weld, and New River, as shown in Figure 4.1 (Forestry Commission, Tasmania 1983a). Within this concession, there has been a major subdivision which no longer applies.

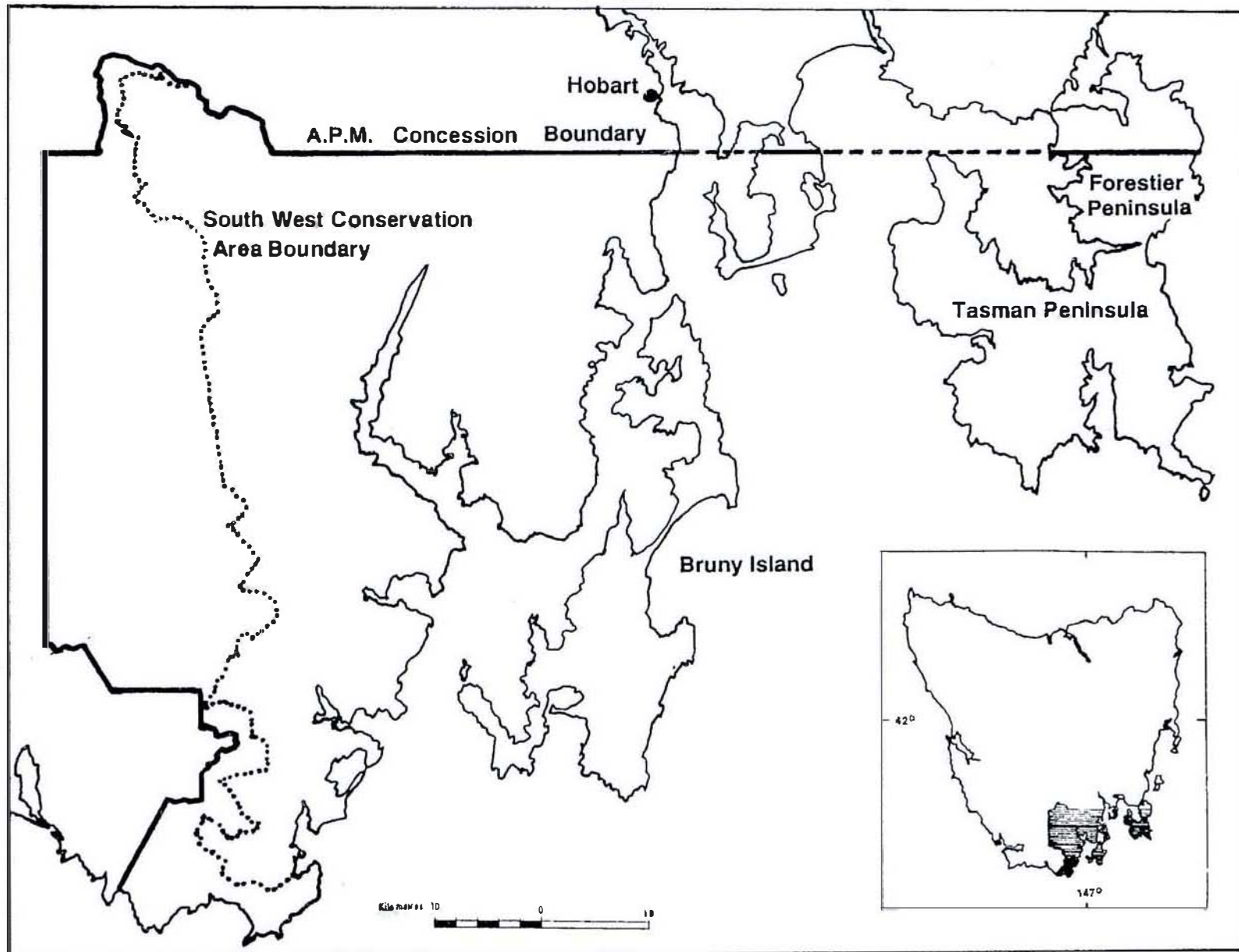
The concession was divided into Pulpwood and Reserve Areas. Wood from the Pulpwood Area is available to the Company for 80 years subject to a minimum rate of operation. Wood from the Reserve Area was available to the Company subject to specified development within 15 years from commencement. This condition was met in 1975 and the whole concession is now available to the Company.
(Forestry Commission, Tasmania 1983a)

Most of the production forests are eucalypt forest dominated by Eucalyptus obliqua, E. regnans, E. globulus, and E. delegatensis. The inland regions are generally either virgin or cut-over, even-aged, old-growth forests (the eucalypts in these forests are over 110 years old). There is some temperate rainforest in regions which have experienced longer periods free from fire than the eucalypt forests,

Figure 4.1

The Southern Forest Concession Area

(Source ; Adapted from Forestry Commission, Tasmania 1983a, Working Plan For The Crown Forests in Southern Tasmania; Forestry Commission, Hobart.)



and there is open eucalypt forest (dry sclerophyll and multiple-aged in nature) near the coast in some places where rainfall is relatively low. For the purposes of the Working Plan, the forests are divided into four types by the Commission :

- (a) "Tall Eucalypt Forest" shall be forest of one or more of the species Eucalyptus obliqua, E. regnans, E. globulus, and E. delegatensis, the mature trees of which have a potential dominant height of at least 33 m.
- (b) "Eucalypt Pulpwood Forest" shall be forest of species other than Eucalyptus regnans, obliqua, delegatensis and globulus, (or synonyms of these species), and in addition includes forest of any of these species the mature trees of which have not attained dominant height of 33 m in the past.
- (c) "Protection Forest" shall be high elevation mountain forest, scrub or grass and defined on maps by the Commission and shall include any reservations of forest from cutting on the banks of rivers and streams as directed by the Commission..
- (d) "Rain Forest" shall be forest of temperate rainforest species dominated by Nothofagus cunninghamii. Trees have dense individual crowns and essentially the forest contains no eucalypts. It is not dependent on fire for regeneration.

(Forestry Commission, Tasmania 1983a)

The Commission has further divided the eucalypt forest into the following categories :

<u>Oldgrowth Eucalypt Forest</u> - forest dominated by eucalypts older than 110 years, including Pulpwood Forest:	62,300 ha
<u>Regrowth Eucalypt Forests</u> - eucalypt forests younger than 110 years, including Pulpwood Forest, which originated before the advent of integrated pulpwood/sawlog operations:	54,700 ha
<u>Second Rotation Eucalypt Regeneration</u> - forest established on coupes clearfelled since 1960, and on areas burnt in recent wildfires (e.g. 1967)	19,200 ha
(Forestry Commission, Tasmania, 1983a)	

Harvesting and regeneration of the tall eucalypt forests is normally carried out under the clearfelling system in which the merchantable trees of a stand are cut over a considerable area, at the one time, and even-aged regeneration is established. Preparation for regeneration generally involves broadcast slash burning with a hot fire in the late summer or autumn. Regeneration is performed by artificial seeding, assisted by natural regeneration in some places. Thinning is not practised in general, at present, since, from past experience, it is deemed uneconomical in the Southern Forests.

4.3 Sustained Yield Estimation

The Working Plan is written so as to maximize the output of sawlog and pulpwood, given present knowledge, practices, constraints, condition of the forest, and the requirements of existing industries at the time the plan was formulated. The principle constraints are A.P.M.'s requirement (up until 1982) that the proportion of old-growth in its total pulpwood supply is less than 40% and the requirement for a certain quantity and quality of sawlog to maintain the sawmilling industry. In the following description of the Commission's technique for determining sustained yield estimates the author has organised the discussion under four distinctive headings. These are rotation age, allowable cut, productive area, and future regrowth and old-growth yields. Under each heading, assumptions pertinent to the parameter in question are identified; all constitute assumptions in the overall sustained yield estimation.

4.3.1 Rotation Age

The long-term harvesting programme of the tall eucalypt forests in the Southern Forests is based on an average rotation age of 85 years for both natural regrowth and silvicultural regeneration. The rotation age of the tall eucalypt forests is set at a time when the harvesting of the forest will yield a certain utilization standard and quantity of sawlog and pulpwood. Although this does not represent maximum mean annual incremental (m.a.i.) yield of sawlog, the yield achieved is close to that of m.a.i. for sawlog (as explained in Chapter 2).

The average rotation is established by determining from "the provisional site index and yield tables" for the Southern Forests (Forestry Commission, Tasmania 1978) the time at which the chosen utilization standard will be achieved. The yields from the pulpwood forests, which have a 45 year rotation period, are not included in the sustained yield calculations of the Working Plan.

The harvesting of the existing natural (first rotation) old-growth and regrowth will be done by cutting over these forests relatively evenly, so that they will be completely harvested in the 85 year period from 1961, when the Working Plan was first drawn up. This is planned in such a way as to give an even-flow of products, comprising a certain quality and quantity of sawlog and pulpwood over the period (that is, the constraints placed upon management, mentioned in the first paragraph of this section, do not allow management to

maximize harvested volume, by first harvesting the old-growth, thereby giving the regrowth forests the longest time period to grow before harvesting).

The projected yields of sawlog and pulpwood in the coming decades (see Figures 4.2 and 4.3) show the resemblance of the predicted wood flow to that of the non-declining even-flow timber yield model. This model has a constrained harvesting schedule in the early years of the conversion of old-growth forest towards a "normal" forest, to allow for an even-flow of wood. The harvest may go up, but not down, as a "normal" forest is achieved.

In the author's judgement, the major assumptions in the setting of the rotation age are :

- A1. that the achievement of a "normal" forest is desirable;
- A2. that, in setting the rotation age according to production criteria, based on a compromise between sawlog and pulpwood standards, volume is the only criterion necessary to be considered for all the different forest types and sites; there is no necessity to consider other criteria such as forest productivity or economics;
- A3. the continuance of the utilization standards for the period of the Working Plan, that is, there will be a continuing demand for the particular standards of wood used in determining the rotation age;
- A4. that the objectives of management will be achieved by spreading the cut of old-growth and regrowth over the intervening period before yields from the regeneration forests are available;
- A5. the maintenance of the type and intensity of silvicultural management used in the Southern Forests for the period of the Working Plan;
- A6. that all the different types and sites of Crown

Figure 4.2

**Predicted Annual Maximum Allowable Cut Of Eucalypt Sawlog For The Decades
From 1980 To 2040.**

(Source : Forestry Commission, Tasmania 1983a, Working Plan For The Crown
Forests In Southern Tasmania; Forestry Commission, Hobart.)

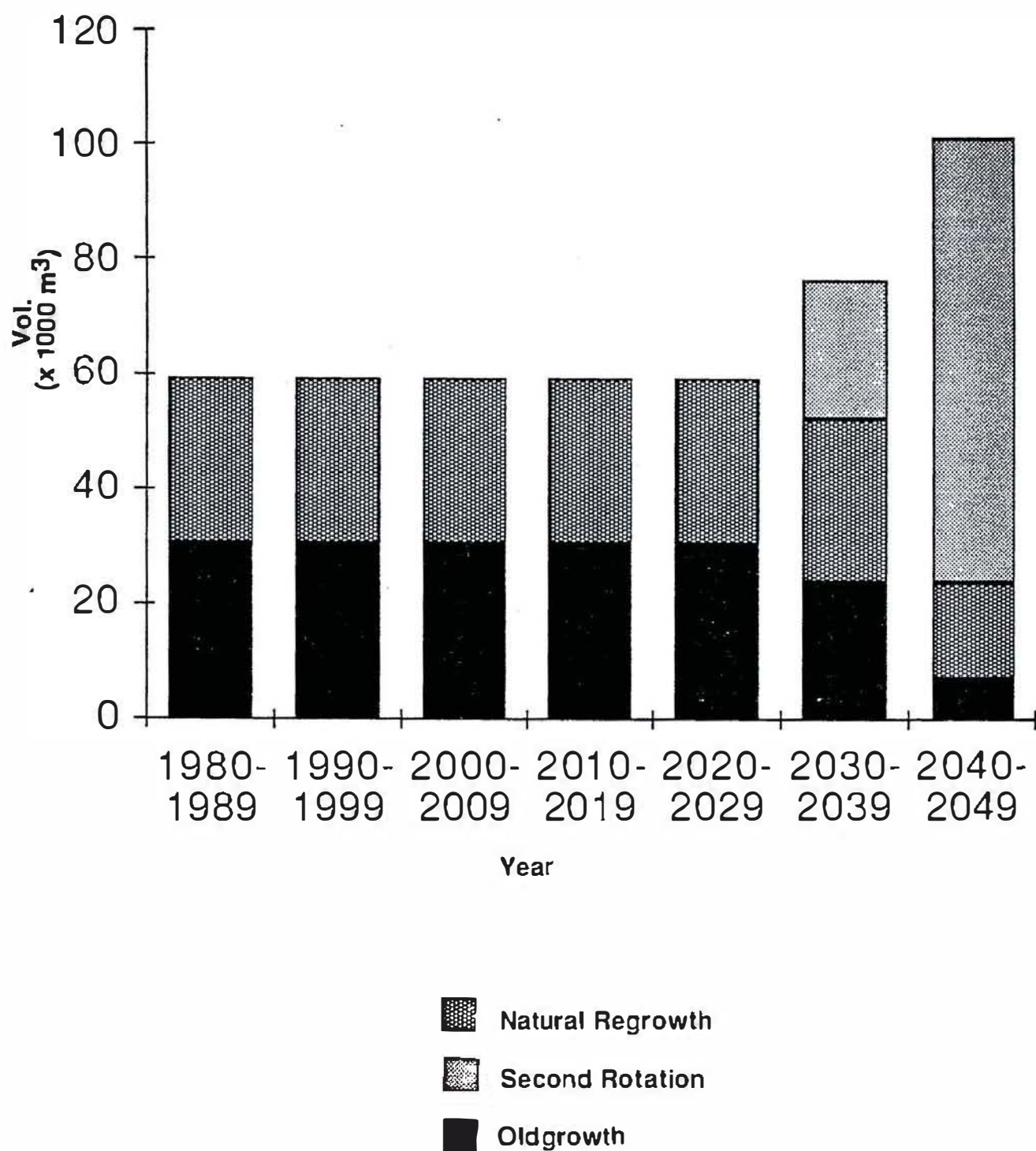
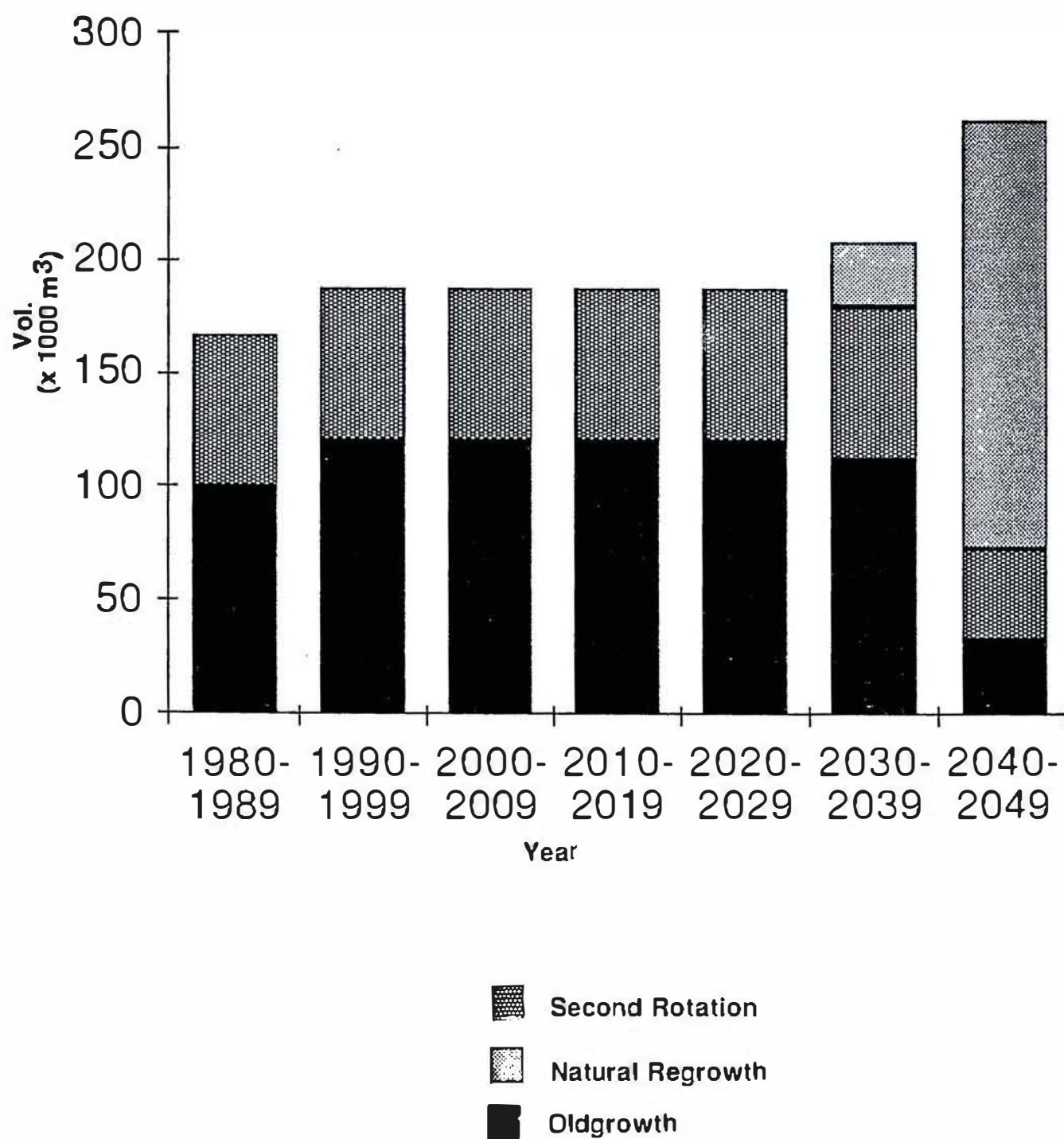


Figure 4.3

Predicted Annual Maximum Allowable Cut Of Eucalypt Pulpwood For The Decades From 1980 To 2040.

(Source : Forestry Commission, Tasmania 1983a, Working Plan For The Crown Forests In Southern Tasmania; Forestry Commission, Hobart.)



forest present in the Southern Forests are capable of regenerating without loss of productivity;

- A7. that old-growth forest is not required in the Crown forests;
- A8. that there is accurate knowledge about the growth and merchantable yield for all the different forest types and sites present in the Southern Forests;
- A9. the continuation of the same wood extraction efficiency at harvesting for the period of the Working Plan.

Furthermore, the assumptions used in preparing the yield table should be added to the above list, since yield table data are used in the determination of rotation age.

A10. the assumptions used in preparing the yield table.

4.3.2 Allowable Cut

Cutting plans in the Southern Forests are based on estimates of recoverable wood quantities at regular intervals in the future, using forest inventory, mapping, and sampling data processed through a number of computer programmes.

The allowable cut for the Working Plan area was calculated by selecting, from a range of options, the cutting strategy which generated the maximum yield of merchantable wood whilst satisfying certain constraints and aims imposed to fulfil silvicultural, management, and industrial objectives. The options were generated using a computer program, 'GROWER' which models forest operations and growth.

(Forestry Commission, Tasmania 1983a)

The constraints and aims mentioned above include A.P.M.'s requirement of less than 40% of old-growth pulpwood in its supply, the

cutting out of equal quantities of good and poor forest throughout the rotation, and the requirement that 60% of the area of regrowth cut annually will come from dieback affected stands until such stands are exhausted.

The GROWER program calculates the area of each forest class left over after each decade's cutting, then consults the cutting strategy provided to see what area of each class must be cut over in the next ten years ahead; it does this for twenty ten-year periods. The yield tables show how much wood can be recovered per hectare of each forest class cut in that period; multiplying these by the area specified to be felled, the total yield of sawlog and pulpwood for the decade can be calculated. The programme then deducts the harvested areas from forest class totals and adds them into a new regeneration class, where the areas will "grow" according to a new yield table, and will once again be available for harvest when they reach clearfelling age. According to the Forestry Commission, the parameters which are listed below are also required, apart from the area, yield, and cutting data input needed for the programme. These parameters represent technical details needed in integrating yield data for the forest simulation model. They also constitute assumptions; as such, the author has applied his own numbering system to the list.

- B1. For each forest class, the net (loggable) area and mean age at 1980 ... [and the] ... average recoverable yield of ash and non-ash sawlog and pulpwood expected to be available per hectare in the middle of each decade... [is known]

- B2. The average delay between cutting and regeneration on a given area is assumed* to be two years...
- B3. ... the area said to be regenerated is 7.6% larger than the area of productive forest cut...
- B4. It has been assumed that when an area of a given natural forest class is prescribed to be cut, other classes (not necessarily ready for felling) must be grouped with it to make up a loggable coupe. The additional area of other classes to be coupé-up and cut with the desired class is equal to 10% of the area of the class desired to be cut.
- B5. One catastrophic wildfire is assumed to occur in each rotation, destroying the equivalent of 35 hectares of regrowth forest per year;
- B6. A plantation program is assumed to establish 1000 hectares of eucalypt plantation on unstocked forest land over the next decade.
(Forestry Commission, Tasmania, 1983a)

In the author's judgement, the setting of allowable cut also assumes :

- C1. that each photographic interpretation (P.I.) type vegetation patch is readily accessible for harvesting, since no locational data are involved;
- C2. that the plan of cuts is followed exactly, that is, there is no delaying the cutting program to salvage wood from a wildfire, for example, as occurred in 1967;
- C3. that the same species and ratio of eucalypts are established and present at the next harvest;
- C4. that the selection of coupes for the harvesting of the various forest classes specified to be harvested is random, since predicted yields used for these classes are average yields which take into account the variation in site index, productivity, and age;
- C5. that there is adequate staff and capital, and that other practical needs can be satisfied to perform the planned cuts; these needs include the required number

* Author's emphases in B2, B4, B5, and B6

of fire days and clear weather days to perform harvesting and regeneration to expected environmental and safety standards.

Further, the assumptions made in the determination of net loggable area and yield data can be appended to this list.

- C6. the assumptions made in the determination of net loggable area and yield data.

4.3.3 Productive Area

The net productive area of the Southern Forests is determined sequentially. First, the gross areas of each P.I.-type vegetation patch is obtained, and then this area is discounted for unloggable areas within the gross area. Gross areas are determined from P.I. maps, on which topographic features, cadastral boundaries, and the type and condition of vegetation are delineated. The details of each P.I.-type vegetation patch are then placed on computer and the gross areas obtained by adding together the areas of each patch within Crown forest, grouped by region and forest class.

The main criteria [used in the P.I.-type vegetation classes] for grouping was the stand's oldgrowth eucalypt height-class potential and density, and in the case of regrowth, stand height at the time of photography and whether or not the stand is affected by Southern Forest regrowth dieback disease.

(Forestry Commission Commission 1983a)

Special management zones (areas of forest which are or may be managed in a special way) are delineated on maps. Areas, such as alpine protection forest, possible future reserves, and pulpwood forest, are not included in the production forests since they are assumed not to be

logged for the purposes of estimating net productive forest. In areas where it is judged there will be constraints on logging, such as visually sensitive or scenic areas and town catchments, 15% of the total available volume is deducted over and above the discounts for the other allowances.

Discounts for unloggable areas take into account two different factors: defined streams and roads, and logging difficulty. The Commission established these discounts by placing a number of regularly-spaced sample points within the Southern Forests, then noting the slope class, forest block, vegetation type, and management zone for each of these sample points. Analysis of these data showed that, on average, about 3.4% and 0.12% of the sample points fell within defined stream reserves and on the present forest road networks, respectively. It also showed that there is no significant difference between the proportion of forests in each of the three defined slope classes (0-19%, 20-39%, 40%+) occupied by old-growth or regrowth eucalypt forest or between Pulpwood or Reserve Areas. Continuous Forest Inventory (C.F.I) plot data is then used to estimate the proportion of each slope class which is loggable by taking into account slope, swampiness, and rockiness. These discounts are then combined to give an estimate of the proportion of forested area loggable in different forest regions and classes.

The author argues that the estimation of net productive forest area assumes :

- D1. that there are no changes in harvesting ability or practices (that is, the same proportion of different

slopes, swampy and rocky land will be logged);

- D2. that there are no other significant discounts to be taken into account; possible discounts which have been excluded include discounts for ecological, biological, or conservation reasons apart from those served by defined stream reserves. Other physical factors, apart from the physical characteristics of landform - slope, rockiness, and swampiness which were considered, may also need to be considered in the determining of discounts;
- D3. that the area of net productive forest is able to be determined using proportional/average estimates and deductions, that is, it assumes random distribution, for instance, of defined stream reserves in each of the forest classes;
- D4. that there will be no variations in the total gross area of each of the P.I. type vegetation classes, that is, it assumes that a P.I. vegetation type will not be subsequently degraded to a different category by such factors as fire or insect/fungicidal attack;
- D5. that P.I. vegetation-type classifications are an adequate means of classifying the forests into different productivity classes, and that these classifications also achieve management objectives, such as that concerning the ban on the logging of rainforest at present.

4.3.4 Future Regrowth And Old-growth Yields

Yield estimates for regrowth, regrowth with dieback disease, and second rotation forests, are based entirely on data generated from Continuous Forest Inventory (C.F.I.) plots. To predict the expected growth in the regrowth stands, the assessed volume of each C.F.I. plot is "grown on" into the future. Volume estimates of sawlog and pulpwood are estimated using a two-stage process. In the first stage, the provisional site index and yield tables are used to predict the Gross Bole Volume (G.B.V.) on each plot for the middle year of each decade in the first rotation, based on age, site index, and plot volume at the date of assessment. These predicted G.B.V.s are then split into sawlog

and pulpwood components by obtaining, from a single-tree distance-independent simulation model, the proportions of available sawlog and pulpwood to total volume for each year for which an estimate is required. These proportions are then applied to the estimate of G.B.V. produced by the stand yield model. The volume estimates from each plot are then averaged within forest classes to give predicted average stratum yields of ash and non-ash sawlog and pulpwood per hectare at ten-yearly intervals from 1985.

These results are only estimates, based on assessed volume. To estimate recoverable yields, records from past regrowth clearfelling operations are used to establish an average relationship between total recoverable volumes and total assessed volumes. These estimates are then applied directly to the predicted volumes calculated to obtain estimates of volumes actually recoverable in practice, which are then tabulated into a yield table format.

The estimates of yield from Southern Forest regrowth affected by dieback disease are treated separately. They are determined in a similar fashion to regrowth estimates mentioned above, except that allowances are made for the slower rate of growth and higher mortality rates than normal in these forests.

Like all the other regrowth yield and growth estimates, the second rotation yields are based on the provisional site index and yield tables. Predictions of G.B.V. for the various stand ages are determined by reading the volume from the provisional site and index tables. Full stocking and continuance of species mixes are assumed. The

proportion of G.B.V. recoverable at clearfelling age as sawlog is assumed to be the same as for the tallest natural regrowth forest classes. Recoverable pulpwood quantities are estimated by deducting the sawlog component from a constant proportion of the G.B.V. shown by experience in these forests to be recoverable as merchantable timber.

Old-growth yield estimates are obtained by extrapolating information from those blocks which have been assessed or cut to the remaining old-growth areas. Forest P.I.-types are then divided into categories which contain significantly different timber volumes. Total recoverable volumes for each of these categories are also estimated from these data. Calculations are also made to determine and allow for sawlog/pulpwood proportions of virgin and cut-over forests, and ash and non-ash species in order to determine average recoverable yields.

These predictions of regrowth yield assume :

- E1. that regrowth stand height, age, and site index (mean dominant height in metres of a eucalypt stand at age 50 years) are appropriate parameters for the division of forests into productivity classes;
- E2. that dieback will not spread or increase in intensity from its present known occurrence, and that it will not be present in the succeeding generation of regrowth in this area;
- E3. that there will be no additional deleterious effects on the growth of the Southern Forests, such as might result from insect attack or disease;
- E4. that the average relative proportions of sawlog and pulpwood obtained by comparing total assessed volume to volumes actually recovered from regrowth coupes is the same for all other sites, stockings, eucalypt species, and mixtures of species found in the Southern Forests;
- E5. that there is no change in the type or intensity of

silvicultural management used at present in the Southern Forests;

- E6. that the techniques, and efficiency of extraction are maintained for the period of the Working Plan and that these are exactly the same for all of the forest classes and sites;
- E7. that there is consistent assessment for each forest class over time, since no error estimates are involved and the assessed volume is multiplied by a constant percentage to determine recovered yield;
- E8. that there is equivalent, average, productivity for each forest class and site in the second rotation;
- E9. that the same species and relative proportions are available at the next harvesting as there are at initial clearfelling;
- E10. that the categories of ash and non-ash are adequate for the purposes of dividing the eucalypts into the same expected yields, that is, that finer definition by species, by sites, or by classes is not necessary;
- E11. that present utilization standards for logs will be maintained for the period of the Working Plan;
- E12. that past regrowth yields are equivalent to those that will be taken from the same classified regrowth forests in the future;
- E13. that the assessed or cut old-growth yields are equivalent to the yields which can be expected to be taken in those old-growth forests left to cut.

Furthermore, the assumptions made in the C.F.I., the single-tree distance-independent simulation model, and the graphical extrapolation used to determine growth can be appended to the above list.

- E14. the assumptions made in the C.F.I., the single-tree distance-independent simulation model, and the graphical extrapolation used to determine growth.

4.4 Conclusion

The method used for implementing sustained yield in the Southern Forests primarily concentrates on providing an even-flow of wood from the forest resource. Provision of non-wood values is attempted in the following way :

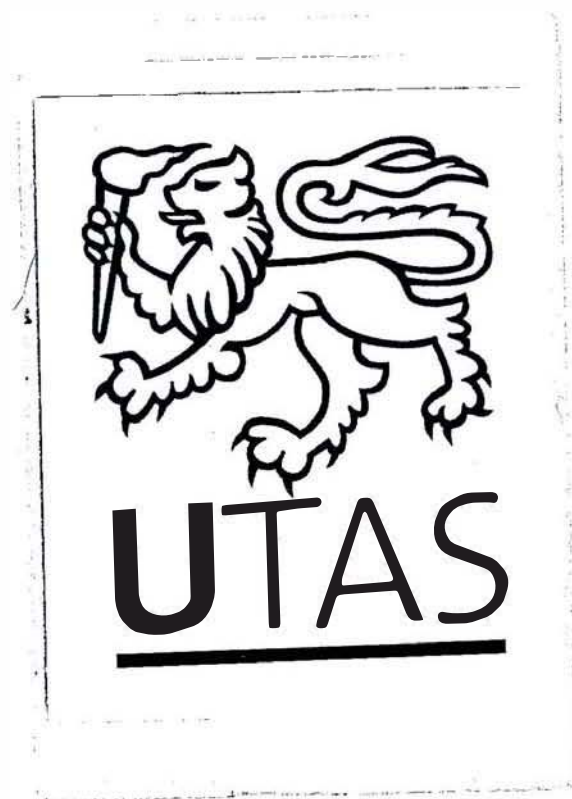
In Tasmania the concept of multiple use management of Crown forests is accepted and applied through a general system of zoning into areas where defined priority uses are constrained by the need to provide for subsidiary uses.

At the broadest level, State Reserves under the National Parks and Wildlife Act 1970 give priority to conservation, and sometimes to recreation. Protected Areas gazetted under the Crown Lands Act 1976 give emphasis to recreation whilst most other forest uses are possible in subsidiary roles. On State forests dedicated under the Forestry Act 1920, wood production is the priority use but recreation and conservation is provided for. Measures are taken to conserve soils, to maintain and protect wildlife, to protect watersheds and water supplies from pollution and degradation and to maintain the aesthetic values of forests.

(Walker 1983)

Management has tended to concentrate on decreasing the effect of wood harvesting on the provision of non-wood values, rather than on positively planning for such other values (Lake 1974). The planning of logging operations and coupe boundaries to minimise soil erosion and visual impact is an example of this negative planning. While this secondary adaptation of forestry practices to minimise effects on non-wood values is extremely laudable, in many cases it is not sufficient to provide for non-wood values. It is the positive planning for non-wood values, which often requires diminution of wood yields, that presents sustained yield management with its greatest difficulties. It will be the function of the next chapter to analyse

the assumptions listed in the present chapter in some detail, in order to show the difficulties that the model of sustained yield used in the Southern Forests poses for the provision of non-wood forest values.



REFERENCES : CHAPTER 4

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CHAPTER FIVE : CRITIQUE

5.1 Introduction

The following is a discussion and examination of the assumptions made in planning sustained yield. The assumptions have been re-grouped in four categories covering similar themes. These categories are as follows :

1. Within Group 1 are the assumptions dealing with the collation and estimation of yield data : A8, A10, B1, B2, B3, B4, B5, B6, C1, C2, C4, C5, C6, D3, E2, E4, E7, E10, E13, and E14.
2. Within Group 2 are the assumptions which relate to the continuation of forest productivity : A2, A6, D4, D5, E1, E8, and E12.
3. Within Group 3 are the assumptions concerning the intensity of, method of, and constraints on forestry operations : A3, A5, A9, D1, C3, D2, E3, E5, E6, E9, and E11.
4. Within Group 4 are the assumptions dealing with the modelling of timber flow, and the harvesting rates of the forests : A1, A4, and A7.

5.2 Group 1 Assumptions

The discussion of the assumptions in Group 1 is organised according to three subgroups for purposes of clarity. All assumptions

in the group are examined, but those which are more pertinent to the discussion topic receive greater attention.

The first subgroup consists of B2, B3, B4, B5, B6, C1, C2, C4, and E2. These assumptions pertain to the pragmatic details of forestry operations. Assumptions B2, B4, and B6, which relate to such details as the delay between cutting and regeneration and the need to allow for logging of forest classes other than those scheduled (that is, due to grouping of various classes to make up a loggable coupe) are logical and justifiable. Assumption B3, which deals with the expected increase in area of productive forest, however, is optimistic in its approach. The authors of the Working Plan recognised the optimism of this assumption but noted that "full stocking has been assumed, since the majority of regenerated stands comply easily with prescribed standards of stocking density. The inherent conservatism of the Southern Forests Yield Table more than compensates for the small minority of understocked stands." (Forestry Commission, Tasmania, 1983a).

Assumptions C1 and C4, which refer to the random distribution of harvesting sites, appear to be naive, since selection of coupes for harvesting is going to be in part dictated by pragmatic concerns such as the location of present and future roading. The effect of given roading networks will be less randomly distributed age classes and forest coupes than planned. However, in the author's judgement, the effects of these two assumptions on yield flow variation are likely to be negligible.

An unsubstantiated assumption about the future behaviour of

the Southern Forests yield from dieback affected regrowth (E2) has been made due to lack of information. The effect on yield estimates of the present occurrence of dieback has been attempted using the best information available. The importance of this assumption, in this examination, lies not in its actual effect on yield estimation but as an example of one major drawback of sustained yield management. In the later examination of Group 3 assumptions, a detailed discussion of the deficiencies incorporated in assumptions which presume unchanging effects, such as the one above, is given. To prevent duplication of argument, the discussion concerning this major drawback to sustained yield management associated with assumption E2 is left until the examination of Group 3 assumptions.

The remaining assumptions of the first subgroup, B5 and C2, pertain to the effect of catastrophic wildfire on timber production in the Southern Forests. The current Working Plan is the first Working Plan in Tasmania to have incorporated a discount for catastrophic wildfire into the yield estimations. While the estimate used (35 ha/yr) is optimistic, given that 69 800 ha of regeneration in the Southern Forests has occurred by wildfire in the period 1962 to 1981 (3490 ha/yr) (Forestry Commission, Tasmania 1983a), it is an improvement on having no consideration of wildfire in management planning. Fire history data relating fire frequency, severity, and type, age, and area of forest affected for the region is fragmented at present, making analysis and estimation difficult. In more recent Working Plans for other parts of the State, there has been more detailed determination of the loss to fire of regrowth forests. To preplan harvesting operations for the effects of the severe periodic wildfire events which are a part of the

Tasmanian landscape is extremely difficult. It is largely a matter of salvaging as much fire damaged timber as possible and adjusting operations as best as possible after the event. This is another externality to forestry operations which makes working to projected maximum harvest levels short sighted. Another point which also should be accounted for is the fact that a growing proportion of the Southern Forests are going to be in the regrowth stage. This makes estimates based on the past effect of fire on regrowth biased towards underestimation, since the data obtained from past records is from a time when there was a smaller proportion of regrowth in the Southern Forests, the most susceptible to fire damage of any of the stages of production forest.

The next "subgroup" consists of but one assumption (C5). Assumption C5, which refers to the adequacy of staff and capital, is another example of a major deficiency in present sustained yield planning. Whilst pragmatic details such as the delay between harvesting and regeneration are accounted for, practical considerations of whether adequate staff and financial capital are always available for management operations are not considered. Present planning of forest harvesting levels does not take into consideration such details as whether there is adequate capital and labour resources available to the local forester to allow restrictions on coupe sites to be made which are deemed environmentally desirable, and to ensure that adequate levels of supervision for the harvesting operations can be maintained (see Ovington and Thistlethwaite 1976; Senate Standing Committee on Science and the Environment, Australia 1977), or whether suitable weather conditions occur frequently enough in the year to allow

operations to be carried out. Operations are commonly restricted in winter due to the degree of soil disturbance and erosion which occurs during this wet period.

The last subgroup of assumptions (A8, A10, B1, C6, D3, E4, E7, E10, E13, and E14) deals with the necessities for collation and use of statistical data as it relates to yield estimation and prediction. Assumptions A10, C6, and E14 are necessary in amalgamating different data sets. The one thing that should be kept in mind, when incorporating a database into planning, is that all the assumptions and stipulations used in generating that database will be incorporated in the integrated model. Assumptions B1, D3, E2, E7, and E10 are all reasonable assumptions pertaining to the statistical analysis of data and generation of new data. As such they have been or can be statistically verified.

Assumptions A8, and E13, which concern the extrapolation of yield data to forest sites where little statistical information is available, fall into the same category as the assumptions immediately above, but are differentiated by their more optimistic perspective. Both assumptions are made using data gained largely from the better quality sites, where harvesting has occurred previously, and extrapolating to the poorer quality sites. Attempts have been made to allow for this factor, however, so that there is likely only to be slight overestimation of predicted yields in these forest classes.

5.3 Group 2 Assumptions

Group 2 assumptions deal with the expected continuation of forest productivity. More precisely, they demonstrate that in the planning of forest harvesting, forest productivity will be maintained under present operations at the same level in perpetuity. The discussion here proceeds in a different fashion to that of Group 1 assumptions. After notes on the general characteristics of each of the assumptions, the neglected role that forest ecology is accorded in forest productivity calculations is covered. However, to discuss the assumptions, it is first necessary to define some parameters pertinent to forest productivity.

Traditionally, continuation of forest productivity has been considered to be based on the maintenance of the physical and biological capability of the land to sustain a continuous forest crop (Waggener 1982). That is, the concern of the forest industries is based on a single product of the forest, namely, wood. More recently, it has been suggested that continuation of forest productivity means the return of the forest to the same successional stage that was present before harvesting (Kimmins 1974). However, this much broader definition of the maintenance of forest productivity is not the one used by the present forest management authorities in Tasmania, as old-growth forest will be eliminated under the present management regime.

The time scale over which the maintenance of forest productivity is to be considered also needs to be defined. As French (1983) noted :

Renewable resources are considered to be those for which utilization and replacement can fit into our social or economic time scale. So it is possible to completely use up a renewable resource, and this is referred to as non-renewable or extinction (e.g. cedar, huon pine etc.).

Thus, over a much longer period of time than the set rotation period, most forests may be able to biologically renew their productivity after harvesting. However, forest productivity is assumed to be maintained in the rotation period.

Assumptions A2, D5, and E1 relate to the criteria used in classifying forest sites into productivity classes. The criteria used emphasize present or past volume characteristics of a forest stand, measured through such parameters as species, stand height, and age. Assumptions A6, D4, E8, and E12 relate to the continuation of forest productivity in all future crops. Both sets of assumptions could be described as naive, and potentially detrimental to continued forest productivity. Use of biomass data as the sole means of classifying forest sites into productivity classes neglects to take into account other criteria related to continued forest productivity, such as the nutrient budget and the interdependency of the components of the forest ecosystem. These are discussed in turn.

5.3.1 Nutrient Budget

As sustained yield of a managed forest is primarily dependent on sustained soil fertility, then the soil is a basic (but dynamically renewed) resource. Thus one of the key environmental criteria of forest management must be the maintenance of soil fertility.
(Crane 1974)

Use of the P.I.-vegetation type classification and site index as a measure for managing and maintaining forest productivity neglects to take into account the important criterion of nutrient budget. As Jackson (1983) notes :

Biomass does not provide a reliable measure of a forestry resource. ... The sustainable yield or continuous cropping ability is always lower than the initial nett productivity would indicate. The actual difference depends upon the rate of nutrient replacement relative to the rate of nutrient removal.

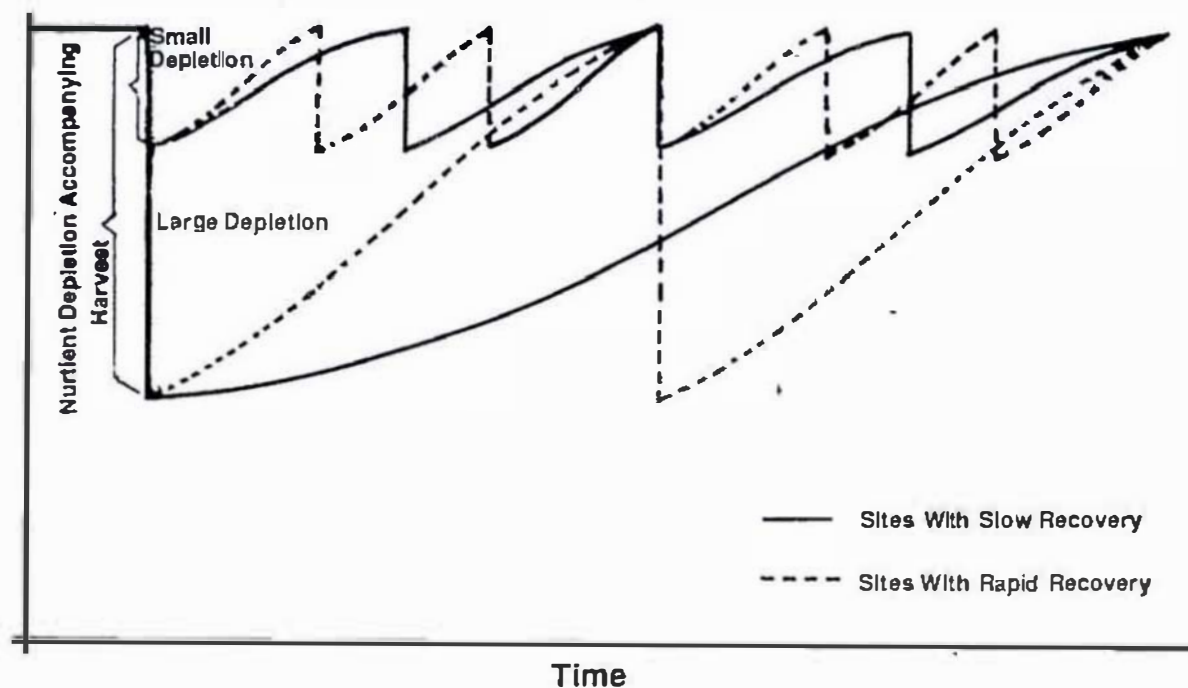
The effects of forestry operations on the nutrient budget is one of the more contentious issues in Australian and Tasmanian forestry, but the facts need to be understood if forestry operations are to remain economically and biologically viable (see Felton 1983). Harvesting and slash burning inevitably result in the loss of nutrients through loss in harvested material, volatilisation, transport of ash, soil erosion and leaching (O'Connell, Grove, and Lamb 1981; Raison 1980 and 1981; Harwood and Jackson 1975; Ellis, Lowry, and Davies 1982). These losses in nutrient capital will be regained given a sufficient recovery period. The time period depends upon the initial amount of nutrient loss, and the nutrient inputs and outputs to which the site is subject thereafter. Jackson (1977) provided the following examples :

On high quality young basaltic soils the loss incurred by each harvest is rapidly made up by the weathering of parent geological material. However, on poor sands or quartzites an insignificant replenishment rate is available from the parent material and the rainfall is the all important source.

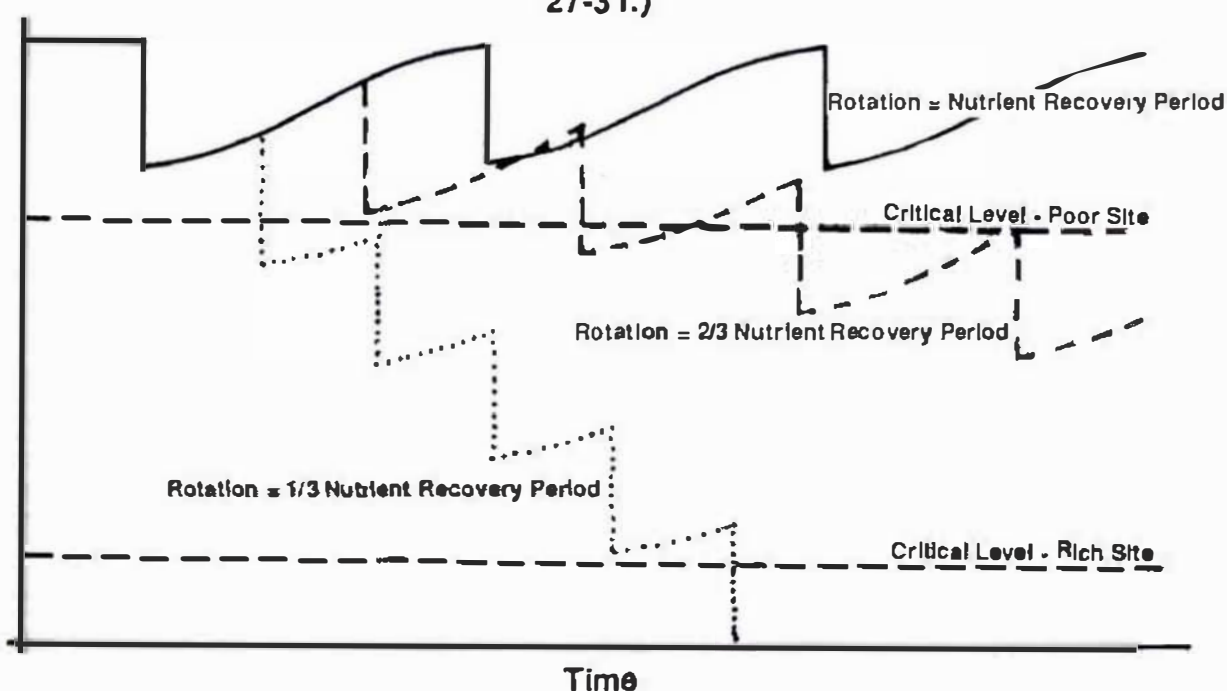
These ideas are represented in Figures 5.1 and 5.2. Figure 5.1 shows the different nutrient recovery periods for nutritional losses of different magnitude on sites with different rates of recovery. The

Figure 5.1**Nutrient Recovery From Harvesting.**

(Source : Kimmins, J.P., 1974; Sustained Yield Timber Mining, and The Concept Of Ecological Rotation; A British Columbian View, The Forestry Chronicle 50, 27-31.)

**Figure 5.2****Nutrient Depletion From Harvesting.**

(Source : Kimmins, J.P., 1974; Sustained Yield Timber Mining, and The Concept Of Ecological Rotation; A British Columbian View, The Forestry Chronicle 50, 27-31.)



rapid recovery site would be similar to the high quality young basaltic soils, while the slow recovery site can be taken to represent the poor sands or quartzites mentioned above. Figure 5.2 shows the effects of operating on a rotation period shorter than the nutrient recovery period, on a site which is generously supplied with nutrients, and on one for which available nutrients are only slightly above the level at which they become limiting to yield. Site nutrient capital will be gradually depleted in this latter situation, since nutrient losses at harvesting are not totally replaced before the site experiences further losses at a subsequent harvesting. Initially, this depletion may not be reflected in loss of tree growth, but if continued will eventually depress the site nutrient capital below some critical level and site productivity will fall. On a nutritionally poor site (where the initial nutrient capital is only marginally above critical level) loss of growth may occur in the second rotation or third rotation, while on the richer site there may be no obvious effects for four or five rotations (Kimmins 1974).

The ubiquitous use of clearfelling and slashburning have potentially disastrous results for poorer sites in the short term and possibly on richer sites in the long term depending on the nutrient budget of the particular site and the method and management of harvesting. Neither the application of these techniques, nor the choice of production forest takes into account the nutrient budget of the particular forest site.

Soil erosion plays a particularly important part in the loss of nutrient capital : "... the basic forest resource is the soil upon which the forest grows..." (Bevege 1981). Forest cover plays an

important role in minimizing soil erosion. Most of man's activities in the forest, which disturb the forest cover, will accelerate soil erosion. Logging increases soil erosion in those areas of greatest disturbance to the forests and soils, that is, snig tracks, roads, and log dumps (Ronan, O'Shaughnessy, and Moran 1983). The factors influencing the extent and rate of erosion are :

- a) Extent of area cleared
 - b) Severity of clearing
 - c) Fire
 - d) Degree of soil disturbance
 - e) Slope
 - f) Soil properties
 - g) Climate
 - h) Rate of revegetation
 - i) Application of erosion control measures
- (Senate Standing Committee on Science and the Environment, Australia 1977)

Planning and control of logging (such as described in Forestry Commission, Tasmania 1981) plays a very important role in minimizing soil erosion from roads, snig tracks, landings, camp sites, etcetera, and thus in regulating the degree of loss in soil fertility for all sites logged. This secondary adaptation of forestry operations to alleviate soil erosion problems may not be enough in many cases where further restrictions on harvesting are required. Yet, planning of sustained yield is performed with the assumption that constraints on yield levels are unnecessary on any sites for the purpose of ameliorating soil erosion levels.

5.3.2 Interactions within the Forest Ecosystem

The eucalypts utilized in wood production do not exist in

isolation from the rest of the forest ecosystem. There are many interdependent relationships of the eucalypts within the forest ecosystem which affect forest productivity, and which forestry operations may inadvertently change for the worse.

The silvicultural management practice used in the wet sclerophyll forests is the best researched and understood of any of the practices used in Tasmania. The wet sclerophyll forest type is the predominant type of forest found in the Southern Forests. The early pioneering research carried out by Gilbert (1958, 1959) and Cunningham (1960) set the pattern of concentrating on attempting to develop silvicultural practices which simulate natural regeneration of overstorey species. Later studies and papers (such as those by Mount (1961, 1976, 1979), Cremer and Mount (1965), Felton (1976), and Felton and Lockett (1983)) have followed the theme of concentrating on the regeneration of the overstorey timber species.

Research concerning the long term productivity of the forests, and the relationships of the understorey to this productivity has been scarce (Ovington and Thistlethwaite 1976; Bevege 1981; Felton 1983). There have been few studies which deal with the localised effects of forestry operations on forest productivity in the production forests themselves (Heyligers 1975).

There are a considerable and increasing amount of data relating to the influence of species on soil properties. In a mixed species forest, the forest soil develops properties varying spatially with relation to the location of trees or understorey species ... it is widely accepted that these influences are significant in maintaining a stable and productive vegetation.
(Florence 1969)

Another example of the complex interrelationships within the forest community comes from the Jarrah forests of Western Australia where fuel reduction burning is practised. The normal low to moderate intensity prescription burning favours the regeneration of such species as Banksia in the understorey to the detriment of legume species regeneration (Shea, Mc Cormick, and Portlock 1979). It has been found that leguminous species create a soil environment which suppresses the growth of Phytophthora cinnamomi fungus (Shea, Gillen, and Kitt 1978). Thus prescription burning, with the resultant changes in understorey composition, may be aiding the spread of dieback in the Jarrah forests.

The currently favoured hypothesis about the unexplained dieback in some of the regrowth areas of the Southern Forests suggests intricate interactions of the eucalypts within the forest ecosystem. It is suggested that the dieback resulted from complex interactions amongst drought, Armillaria (root-rot pathogen), and insect defoliation, according to Podger et al. (1980). Management's use of predominantly biomass data for planning its operations ignores the complex interrelationships between the forest ecosystem and forest productivity which the above example suggests exists.

Silvicultural practices which change or eliminate species in favour of others may have detrimental effects on the long term productivity of some forests. One of the changes which may effect forest productivity is the change in the fire regime brought about by the practice of fire hazard reduction burning, and the increased fire frequency associated with the development of an extensive forest

roading system generated by forestry operations.

The possible long-term effects of low intensity, but frequent protection burning on the stability and productivity of the eucalypt forest ecosystem, through partial destruction of the forests lower shrub storey, needs extensive study.

(Florence 1969).

The forest entomological literature indicates that insects and understorey vegetation are interrelated, and that insects can benefit their host plant and vice versa (Petelle 1982, and White 1984). Thus, any plant species compositional changes might be expected to effect insect numbers, speciation, and their role and rate of regulating nutrient cycling in the disturbed forest following logging and burning.

(Forest Action Network 1985)

Another of the possible changes which may effect forest productivity is the shift in the forest age structure towards earlier successional stages. More and more of the Southern Forests will be in the regrowth development stage and thus may be more susceptible to climatic extremes, disease, and insect attack (Opie, Curtin and Incoll 1978). The shift and maintenance of forest age structure towards a much greater proportion of young regrowth forests also increases the vulnerability of the forests to fire.

The suggested rotation times for burning are at the lower end of the fire frequencies postulated for most vegetation types. The long term ecological effect will be an increase in fire danger, not a decrease, because this large scale burning is accelerating the trend towards pyrogenic [produced by fire] plant communities.

(Cadman 1985)

Cadman (1985) also concludes that rainforest species are likely to be eliminated under current fire management practices. Despite increasing fire suppression management, international and national experiences suggest that fire disasters in the forest environment will remain at about the same frequency, but that the

economic loss from fire disasters is increasing with the increased level of human management and reliance on the environment (White 1979, Cheney 1979). None of the above considerations are currently incorporated into the planning of forestry operations.

There is also potential danger to continuation of long term forest productivity with the artificial seeding in regeneration programmes (Duncan 1985) :

Retained and cull trees are the major sources on coupes which have received an intense burn. If the culls were left standing because of non-merchantability, their progeny could also be genetically inferior in terms of wood production.

Random distribution of aurally sown seed may result in unsuitable as well as suitable genotypes being sown into the variety of habitats usually present in a coupe.

From the above discussion it can be seen that in using criteria concerned solely with present or expected wood volume for classifying productivity classes, there is very real potential for loss in productivity in many forest sites. The Southern Forests are quite fortunate in terms of soil fertility, since most of the area has a relatively rich, not easily erodible dolerite soil. The point is, however, that under the present means of implementing sustained yield, important criteria such as nutrient budget and population dynamics are not considered in the primary stages of planning. Loss of nutrients may be easier, though costly to replace, but loss of topsoil and disruption to the forest ecosystem cannot be simply remedied.

5.4 Group 3 Assumptions

Group 3 assumptions suggest that forest practices and management are static in their incidence and intensity, that is, there is no variation. These assumptions have a potentially significant effect on forest management, in particular, management's ability to incorporate non-wood values. The assumptions are discussed in three subgroups. The final subgroup is the most pertinent to the examination. Accordingly, the discussion for this part is considerably longer, being broken up into three sections. Following those, there is discussion of the adaptability of sustained yield to incorporate the provision of non-wood values.

The first subgroup of assumptions, A3, A9, D1, E6, and E11, deal with the maintenance of harvesting practices and efficiency of utilization. These assumptions are conservative in terms of yield levels. Research and trial programmes such as the "smallwood" salvage operation by Forest Resources to recover additional pulpwood to that conventionally defined as such, are likely to lead to additions to the yield/hectare levels presently achieved. Utilization of lower quality sawlogs for milling is also likely to increase in time as, the overall reduction in sawlog allocation continues (Tasmanian Woodchip Export Study Group 1985). Timber resources on rocky or steep land which are presently not included in yield estimates could be utilized in future as new harvesting techniques prove to be economically feasible. Logging steeper slopes and rocky land may, however, be environmentally inadvisable.

The next subgroup is made up of assumptions A5, C3, E5, and E9, which relate to the maintenance of the type and intensity of silvicultural management. Assumptions C3 and E9, which refer to the maintenance of species types found before harvest, are of a conservative nature. Maintenance of the same species and their relative proportions after harvesting does not maximize potential volume for the site. Favouring the highly productive species in regeneration programmes would increase production levels. The Commission should be commended for its present practices in this area which are less harmful to non-wood values such as flora and fauna protection, recreation, and aesthetics than the scenario of volume maximization through species manipulation.

Assumptions A5 and E5 deal with the maintenance of the type and intensity of silvicultural management. These assumptions are also conservative. Yields are likely to increase in the future as better management practices develop and the intensity of management increases with greater economic incentives. The forests presently being harvested were free from initial establishment costs. But as the present old-growth and natural regrowth are harvested there will be greater economic incentive to increase the intensity of management.

The last subgroup of assumptions is made up of assumptions D2 and E3. These assumptions are the most pertinent of the Group 3 assumptions to this examination. These two pertain to the amount of land which needs to be discounted from the Crown forest in order to obtain the "productive" forest area. This discount or withholding of

land from production forestry is assumed to be constant in the planning of present and future harvesting. Constraints on timber production for the provision of non-timber values are, however, more than likely to increase in the future. Three possible factors which may require further discounts to be made to yield estimates are posited and will be discussed in turn.

5.4.1 Recreational Discounts

Forests provide for a wide range of recreational pursuits, which either intimately involve the resources of the forest or use them as a backdrop for activities. The forest environment may be enjoyed while travelling through it, either by vehicle, horse or on foot. It can be savoured as a place to visit while picnicking, camping, or spending a night at a chalet or hut, or it may provide the facility in which sporting activities take place, such as fishing, skiing, hunting, hiking, canoeing, and swimming.

Roading associated with the maintenance and development of forestry operations allows many of the recreational users of forest resources greater accessibility. The main conflict associated with this roading activity, however, is with the provision of wilderness value. Wilderness is incompatible with both roading and forestry activity. The potential effect of forestry operations in the Southern Forests on Tasmania's South West wilderness is described by Harwood and Kirkpatrick (1978) and Kirkpatrick and Haney (1980).

The analysis performed by Kirkpatrick and Haney (1980) suggested that if development of forestry operations proceeded to the boundaries of the Southern Forests there would be a reduction of 22.8% in the South West Wilderness resource as of 1979. If the wilderness resource was to be completely protected, it would result in a loss of 467 000m³ of old-growth sawlog and 929 000m³ of old-growth pulpwood from the Southern Forests. The Forestry Commission does not intend to significantly alter their proposed operations in these areas, at present, since there are no special allowances for expected reductions in yield in these areas which would result if operations were to be curtailed to fit in with wilderness values of the adjacent area.

The provision of aesthetic protection, an important consideration in areas used by recreationists, is through a scheme of landscape management, recently introduced into the Southern Forests. The scheme uses a system of landscape management zones (which signify the relative visual importance of forested areas) to minimize the impact on the landscape by planning operations within these zones. Only the volumes of expected wood yield from the visually sensitive or scenic areas are discounted due to constraints on logging operations. "A significant part of the visual resource lies in the protection forests" (Forestry Commission, Tasmania 1983b). Thus landscape management as it is practised now does not significantly alter the expected wood production levels from the Southern Forests. However, if priorities were to change towards a greater concern for aesthetic protection, provision for aesthetics may well require some reduction of potential yields.

5.4.2 Flora and Fauna Protection Discounts

To date there has been little positive planning for flora and fauna protection within the Southern Forests. This situation is not helped in any way by the paucity of information relating to the flora and fauna resource in the area, as noted by the Commission :

There is comparatively little published information about the plants and animals which occur in the area. More extensive and detailed surveys are required before any conclusive statement about biological conservation can be made.

(Forestry Commission, Tasmania 1983a)

This does not, however, impede a general discussion of the potential constraints which the present method of sustained yield management may pose in providing for flora and fauna conservation.

"The forests of Tasmania represent the major habitat resource for the State's mammal fauna with all but two species ... known to be regular inhabitants of a least one major forest type" (Reid 1985).

Timber harvesting, by clearfelling, changes the forest habitat by altering forest structure and species composition. The degree to which wildlife is affected depends on the degree of dependence on the forest of the animals living in it (Mc Ilroy 1978). Dr Tyndale-Biscoe and Mr Calaby, in evidence to the Senate Standing Committee on Science and the Environment in 1977 stated :

In any ecosystem, the animal inhabitants can be considered under four headings of increasing dependence on the forest:

1. There are transient species that use the forest infrequently or occasionally. Species for instance, that pass through the forests during migration.
2. There are marginal species whose main habitat adjoins the forest but who may use the forest ecotone.
3. There are non-dependent residents, which are found predominantly in the forest, but are not absolutely dependent upon it.
4. There are dependent residents for whom the forest provides essential requisites for their survival.

Clearly the degree to which a species is affected by alteration or destruction of the forests will be directly related to its place in this classification. However, it is by no means a simple matter to ascribe a status to a particular species without a thorough study of its life history and ecology.

(Senate Standing Committee on Science and the Environment, Australia 1977)

Clearcutting of the tall forest trees favours the increase in total wildlife population for those species in 2 or 3 above whose optimal habitat is the forest edges for shelter and open areas for grazing. However, those species in 4 above which are dependent on Tall Open Forests are the ones most severely affected by clearfelling operations (Tyndale-Biscoe and Calaby 1975). The conservation of these species could present a major area of conflict with present management, since, as Walker (1983) noted :

State Reserves alone do not adequately safeguard Tasmania's forest communities. Therefore State forests and similar areas have a vital role to play in wildlife conservation. For instance, communities producing timber of high commercial value are under represented in State Reserves.

If conservation measures were to be found desirable it would require a reduction in yields, since the reservation of areas would be in the

highly productive (wood) sector of State Forests which have previously been incorporated into present and future yield calculations.

There are three Forest Reserves in the Southern Forests, which are formally gazetted reservations of State Forest of long term intent for recreational, scientific, aesthetic, environmental or protection purposes (Forestry Commission, Tasmania 1983a). These are :

1. Tahune (102 ha) reserved for flora conservation, and scenic and recreational purposes;
2. South Weld (46 ha) reserved for scenic and recreational purposes;
3. Fortescue (1470 ha) reserved for scenic and recreational purposes.

The area, type, and number of reserves indicate the present paucity of formal protection afforded to flora and fauna within the Southern Forests.

There is also evidence to suggest that fuel reduction burning can effect faunal populations :

The timing of prescribed burning, often undertaken during spring in Tasmania, can also directly affect the short-term response of some animals. Disruption of spring breeding activity by birds which nest close to the ground and small mammals can reduce population recruitment, while nectivorous birds can be adversely affected by the depletion of food resources if flowering shrubs are burnt.

While the long term effects of low intensity prescribed burning regimes on the fauna remain to be investigated, any habitat modification due to change in floral composition or soil nutrient status will be associated with corresponding changes in faunal

composition and distribution. Where high fire frequencies are adopted, the promotion of a grassy groundstorey and suppression of the shrub understorey will increasingly favour species that prefer open habitats ... at the expense of others adapted to sheltered scrub habitats.

(Tasmanian Woodchip Export Study Group 1985)

Aquatic fauna protection may also be inadequate, since riparian protection strips for the upper two kilometres of a watercourse are not required in present forestry operations (Michaelis 1984). At the moment the only constraint on wood production in the Southern Forests, apart from the alpine and protection forests, for flora and/or fauna protection is the State Forest reserve at Tahune. This reserve is only 102 ha in size. Future reserves for wildlife conservation will need to be far larger if they are to be effective (see Tyndale-Biscoe, and Calaby 1975; Senate Standing Committee on Science and the Environment, Australia 1977; Bosworth, Dorney and Tarran 1976).

Concerning flora conservation, Dr. Heyligers, in a submission to the Senate Standing Committee (Senate Standing Committee on Science and the Environment, Australia 1977) described the possible long term effects on the forest ecosystem in these words :

As the harvesting of timber and the regeneration of the cut-over areas progresses, the original forest estate will gradually be broken up into even-aged regeneration stands of increasing year-classes. Remnants of the original forest cover will exist as stream, road, and other amenity reserves, national parks and similar reserves, scientific reference areas, and land too steep or with too poor a tree cover to be logged.

The biological and ecological consequences of this large scale and systematic alteration are difficult to predict. The regeneration stands will be managed for optimum timber production and this simplifies the forest ecosystem in the sense that it reduces the natural

variety. This process will be enhanced through regular prescribed-burning which will be carried out in all but the wetter forests. There could be unforeseen repercussions on the genetic stability of populations, e.g. increased hybridization between eucalypt species; increases in population densities of organisms which are favoured by conditions of the younger regeneration stands; and decreases in or even extinctions of populations of organisms which depend on large tracts of old forest.

Specht et. al. (1974), in their report on the conservation of major plant communities in Australia and New Guinea, noted a number of plant alliances in the number 10 biogeographical region of Tasmania, within which the Southern Forests fall, which were unprotected or poorly protected in existing reserves. This may also affect forest management since the potential protection of these alliances will require more than secondary adaptation of forestry practices. Roding and logging associated with forestry operations may also act as vectors for the increased occurrence of diseases, exotic plants, and animals in forests (Palzer 1985).

Normal rotation periods for wet sclerophyll regrowth forests will preclude attainment of old age classes which could result in local elimination of species such as epiphytes which are strongly associated with old-growth forests.
(Duncan 1985)

5.4.3 Water Catchment Protection Discounts

In examining water catchment protection in Tasmania the following comments are particularly pertinent :

Unfortunately the literature available on Tasmania's Water Resources is limited. Virtually no information exists from Tasmania on the effects of land management practices, such as forestry, on either water

quantity or quality. It has therefore been necessary to draw heavily on information from elsewhere. Direct extrapolation of this data to Tasmania may not always be appropriate, but many of the general effects of forest practices will apply.

(King 1985)

A continuous cover of forest is probably the best protection for a water supply catchment to minimize erosion and water quality deterioration. Forestry operations with their roading, harvesting, and regeneration activities can have a major impact on both the quality and quantity of streamflow, and the proportion of stormflow and baseflow (Langford and O'Shaughnessy 1976). The degree of impact that a forest operation has depends on the following factors :

- (a) The specific site conditions. Geology, soil, climate, topography, and forest type have a major bearing on the effect of a particular operation.
- (b) The scale and location of the operation in terms of the total catchment. In some operations only small areas may be affected at any one time, although disturbance in a sensitive location can produce effects of regional significance.
- (c) The persistence of any effects. The comments on scale should be qualified. If effects of a forest operation persist then the influence of repeated small scale operations can build up over time until they assume regional significance.
- (d) The quality of management. Planning, the zoning of sensitive areas, the formulation of prescriptions and restrictions, and last but by no means least the quality of field supervision.

(Langford and O'Shaughnessy 1976)

Roading in a forest catchment is one of the major sources of sediment in streams, adversely affecting both the quality of water and the aquatic ecosystem (Feller 1980). Recent research into the effects of well managed roading and wood harvesting on a catchment area in Victoria concluded that stricter prescriptions for logging roads, governing intensity (the number of stream crossings per unit length of

stream and the length and slope of road draining towards each stream crossing), drainage, and maintenance are essential if water supply is a high priority use for the area (Melbourne and Metropolitan Board of Works 1980). Compaction of soils along roads, snig tracks, and log landings can result in overland flow which in turn leads to increased soil erosion and transport of sediment in streams, as well as accelerating stream bed and bank erosion (Langford, and O'Shaughnessy 1976, Feller 1980).

Water yield (quantity) can also be affected by forestry operations. Changes in the age, structure, density or species composition brought about by forestry practices can be responsible for this change (Ronan, O'Shaughnessy, and Moran 1983).

Thinning a dense forest stand by significantly reducing its basal area will generally result in an increase in water yield at least in the short term.
(Ronan, O'Shaughnessy, and Moran 1983)

The estimating of wood yield levels cannot be segregated from water catchment protection concerns. The two must be fully integrated into management decisionmaking, since they are not mutually exclusive. It would be naive to assume that the 15% reduction on all forest sites for streamside reserves and other purposes would act as an adequate means of protecting all water catchment areas for their water yield. To apply a blanket percentage discount neglects to take into consideration the degree of compromise between timber and water yield desired and the individual characteristics of the water catchment.

5.4.4 The Adaptability of Sustained Yield

To appreciate the significant indirect effect that Group 3 assumptions have upon the provision of non-wood values, it is necessary to refer again to a historical perspective in Tasmanian forest management.

Historical precedent, and present-day administrative arrangements of sustained yield management in Tasmania often preclude sensitive adaptations to the changing values and demands of society. Initially, forest management was primarily introduced into the State to bring under control the escalating overexploitation of the timber resource. Later Government allocations of large forest resources to attract industries meant that the forest service has virtually been fighting a rearguard action, from its genesis to the present date, in trying to limit the timber harvest levels to that thought to be the maximum sustainable yield. Lack of knowledge of the resource, and industry and government pressures to maintain previous harvest levels have, however, resulted in the continuation of overcutting. The decrease in planned sawlog yield levels over the past few decades is evidence of this fact. The outcome of present and future sustained yield management planning appears to be prone to the same result.

In estimating sustained yield levels, a number of assumptions make the predictions susceptible to errors of overestimation. These include the permanency of the land base for wood production, continuity of forest productivity on all sites logged and the presumptions that there is accurate knowledge about the growth and merchantable yield for

all forest sites, that the effect of wildfire can be allowed for by using an average yearly discount figure, that there are no other significant discounts to be taken into account (such as for conservation and recreation purposes), and that there will be no new insect attack or disease to affect growth. These assumptions are typical of a model of management in which the focus of attention is upon economic development, in this case timber production, and concern for environmental matters is treated as an afterthought. A problem with the system in Tasmania is that, initially, provision for non-wood values was minimal. Consequently, as better provision for non-wood values is incorporated into management operations, the land base for production forestry, which can be equated to potential wood yield levels, will have to be reduced. The work presented in the previous sections illustrated that future provision of non-wood values and assurance of forest productivity may require a reduction in potential yields. Thus, if extra provision for non-wood values is made, existing harvest levels will then be recognised as overcutting the forest resource.

Wood industries have been favoured by the historical development of forest management in the State. Their main resource, wood, has been and still is the primary objective of forest management. These industries have the most to gain in advocating the maintenance of the status quo, since any change to incorporate broader non-wood objectives into forest management is likely to result in reduction of wood production levels. As well, previous commitments of certain quantities and qualities of wood resource, by the State Government, and later, under the guise of planned sustained yield levels to industries,

has resulted in the development of an infrastructure to utilize the level of resource being harvested (a level beyond sustainable even-flow). It is understandable that these industries are reluctant to accept any changes to present operations and that they campaign vigorously for the retention of present means of management. Reductions in past harvest levels have, however, been necessary as better timber inventory data has been collected and overcutting practices recognised. Any additional reductions on top of these, however, due to provision of non-wood values, are likely to be extremely unpalatable to both the wood industries and the State Government. The political pressure upon the Forestry Commission to keep to a minimum any reduction in harvest levels will preclude adequate consideration of non-wood values. This introduces a large degree of inflexibility into a forest management regime which was initially based upon poor resource knowledge and with little incorporation of non-wood values. While non-wood values can be partially provided for, using secondary adaptation of forestry operations, this will be inadequate in the provision of many non-wood values which require diminution of wood yields.

5.5 Group 4 Assumptions

The discussion of Group 4 assumptions is divided into two subgroups. The assumptions in the first subgroup, A4 and A7, deal with the rate and extent of old-growth harvesting. Assumption A4 comes from the desire on the part of the planners to create a non-declining even-flow of timber. Economically, it would be more rational to cut out the old-growth forest as quickly as possible, thereby placing the

entire forest resource into a more productive stage earlier than the even-flow regime. The policy of cutting out the old-growth forests over the entire rotation period does allow a greater degree of flexibility to management concerning a possible change in assumption A7, that is, that no old-growth forest is required in State Forests. Old-growth forests are present for a longer period under this regime to allow for a change in policy to retain some of them.

Assumption A1 deals with the desirability of planning forest management with the aim of achieving a "normal" forest. Economists have been the main critics of this planning model. In view of economic criteria, the "normal" forest model has a number of deficiencies. The main arguments, from this point of view, against the traditional method of sustained yield are :

1. Sustained yield management treats timber production as only a biological function rather than a response to economic demand.
2. It ignores the costs involved in producing a fixed quantity, i.e., production is carried on irrespective of price fluctuations resulting in inefficient allocation of the resources of society.
3. Fixed supply is not only economically inefficient but ignores the possibility of changes taking place in the use of forest products due to changes in technology and social values.
4. Sustained yield management ignores the interrelationships between forestry and other sectors of the national economy.
5. Such a rigid policy is not suitable for a dynamic or growing economy.
6. A price responsive supply will cause less severe fluctuations in prices and whatever changes in prices do occur will automatically regulate the demand.
7. In practice sustained yield has merely been an ideal

and wide fluctuation in the actual yield obtained is quite common.
(Joshi 1974)

The social benefits reputedly achieved by sustained yield have also been questioned by economists such as Waggener 1977, 1978; Beuter and Schallau 1978; Samuelson 1976; and Behan 1978, and a social scientist, Stankey 1976.

Foresters suggest that the application of economic principles by themselves, in preference to the sustained yield model, does not give adequate attention to the social objectives and biological considerations in forest management policy. As Pant (1977) notes, "forestry is an activity beset with important externalities such as soil and water conservation, flood control, pollution abatement, prevention of silting of dams and water reservoirs, recreation, aesthetic and wilderness values and numerous other intangible benefits which cannot be measured and are beyond the realm of economics". There is also a fear that if production levels are left only to be determined by profitability that the resource will be mined. "We must recognize that the true source of forest wealth resides in the forest ecosystem...the essential characteristic that sets the forests apart from most other operating systems, [is] the unity within the growing stock of producing plant and product" (Thirgood and Haddock 1968).

Sociologists, such as Lee (1982 and 1983) and Burch (1979), suggest that sustained yield has been used as an instrument of social order. Both in the U.S.A. and Australia, foresters have advocated the adoption of sustained yield during periods of chaotic timber harvesting

as a means of creating social stability. Lee (1983) also suggests that sustained yield has been used as a symbol for social continuity.

To fulfil our obligation to our descendants and to stabilize our communities, each generation should sustain its resources at a high level and hand them along undiminished. The sustained-yield of timber is an aspect of man's most fundamental need : to sustain life itself. (Lee 1983)

Kimmins (1973a, 1973b, and 1974) has argued that the production system in forestry, the forest ecosystem, is not recognised enough in the economic approach.

"Unfortunately for those economists who would manage the forests in response to short term market fluctuations, a forest is a highly complex, four dimensional biological system. It is not a two dimensional area on a map nor a figure in a volume table. The ecological consequences of harvesting are myriad in number, and their social acceptability is a function of both the kind, rate, extent, location, and spatial distribution of the harvesting". (Kimmins 1974).

This study has shown that sustained yield as practised in the Southern Forests is not based solely upon the biological function of the forests as economists suggest. Sustained yield management treats the forests as an isolated tree factory. A tree factory in which production estimates are prone to continual overestimation. The main concern is in trying to regulate the output. This has a number of disadvantages for forest productivity in perpetuity, and for the provision of non-wood values in an extensive forestry operation, as demonstrated in this chapter.

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CHAPTER SIX : CONCLUSION

6.1 Forestry or Forest Management ?

It is no longer sufficient to consider a timber management plan as the equivalent of a forest management plan, it is also no longer sufficient to consider a timber inventory the equivalent to a forest inventory.
(Alston 1983)

A fundamental deficiency of "forest management" in Tasmania, which this study has demonstrated, is summarized in the above quote. "Forest management" in Tasmania concentrates on providing an assured undiminishing flow of wood products from the State Forests (under Alston's classification this would be called timber management). The following features of forest management in the State bear witness to the predominance of wood production objectives in forest management and inventory data collection: yield tables representing only the present intensity of management, the timing of harvesting solely on the production of a certain quality and quantity of wood, classification of forests according to stand height and age, and the division of species according to timber output.

Given the historical development of forestry in the State, the Forestry Commission has done and is doing a fine job in attempting to regulate the harvesting and regeneration of State Forests. The traditional principles of sustained yield have been a valuable tool in bringing about this control of forestry operations. They provided a methodological framework for local forestry managers to emulate, and an

objective for management to achieve, albeit ill-defined, which was attractive to government and public alike, namely, the cessation of mining of the forests in favour of regulation of the harvesting of a renewable resource. These principles still act as the main means of determining the rate and extent of forestry activities in the State. They will have an important role to play in future management, but a role which must differ from that of the past if a planned balance between wood and non-wood objectives is to be achieved.

The present imbalance between the systematic provision for different, competing, uses has eventuated more from a laissez-faire system. Wood production was the first use to gain dominance as an objective of "forest" management, not any positive planning or decision-making to develop the present mixture of wood and non-wood values. Non-wood values have been accommodated in a piecemeal fashion, and only to the extent that they can be incorporated without detracting significantly from wood production levels.

The main inadequacies in providing for forest productivity and non-wood values, whilst using this technique of secondary adaptation to forestry operations, were documented in Chapter 5. Included, amongst these was the potential loss of productivity on some poorer sites due to the indiscriminate application of a single silvicultural practice to a large, heterogeneous forest base. There was also the inadequate provision of non-wood values, largely through secondary adaptation of forestry operations and the zoning of small, mainly non-commercial, areas of forest for recreational, scientific, aesthetic, and environmental purposes.

With sustained yield estimates (allowable cut) being used as timber production targets, it has been shown by the study that the ability of management to adapt to changing needs is going to be quite severely restricted. The most recent of these changes in values is the shift in public expectations, which has suggested adjustments towards greater provision of non-wood values in forest management. This inflexibility manifests itself especially in an extensive forestry operation, such as that found in Tasmania, which has a large native forest resource, much of it in a natural state, and where both wood and non-wood objectives are sought by the community. Adherence to the present methods of utilizing sustained yield estimates will lead to the continued advancement in the techniques for the collection and compilation of timber inventory data, at the risk of ignoring forest management. Strict adherence to the present methods results in little effort being expended in collecting forest inventory data which relates the physical, and biological potential, of particular ecosystems to produce various levels and mixtures of outputs involving alternative management practices.

Technical expertise in the collection and compilation of timber inventory data, such as the Forestry Commission can now claim to have developed, is not the only ingredient for sound forest management. The predominant use of this timber inventory data in the planning of forest management neglects to take into account the interdependent relationships between the ecological, economic, and social values of the forest ecosystem. The traditional role of sustained yield principles in forest management is going to have to change from its

present position of predominance in management planning to a situation where consideration of other ecological, social, and economic values is given appropriate weight.

One of the first prerequisites in the transition from the present timber management regime to a forest management regime is a shift from the present situation where only timber resource data is collected in any detail to a situation where the collection of ecological, social, and economic data is given equal emphasis. In this way, social, economic, and ecological data can be made use of in the primary stages of planning. Various alternative management practices can be examined in the light of the mixture of values which each regime produces. This then allows a choice to be made as to the most desirable management practice. The lack of these data presents an effective barrier to discussion or debate on the relative merits of the current method, and on alternative methods of management. A result of this barrier is retention of the status quo, with management having little ability to sensitively adapt to changing values.

The problems resulting from the allocation of most of the Southern Forests forested land to timber production can be solved relatively simply in principle. A reduction in the area allocated to timber production and the allocation of land specifically to non-wood values and to an uncommitted reserve of land is all that is needed. The uncommitted land would act as a buffer, enabling managers to cope more flexibly with changes in management objectives. However, historical precedent and the current political climate in Tasmania make such actions far from easy to achieve.

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